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NATURAL HISTORY

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1955

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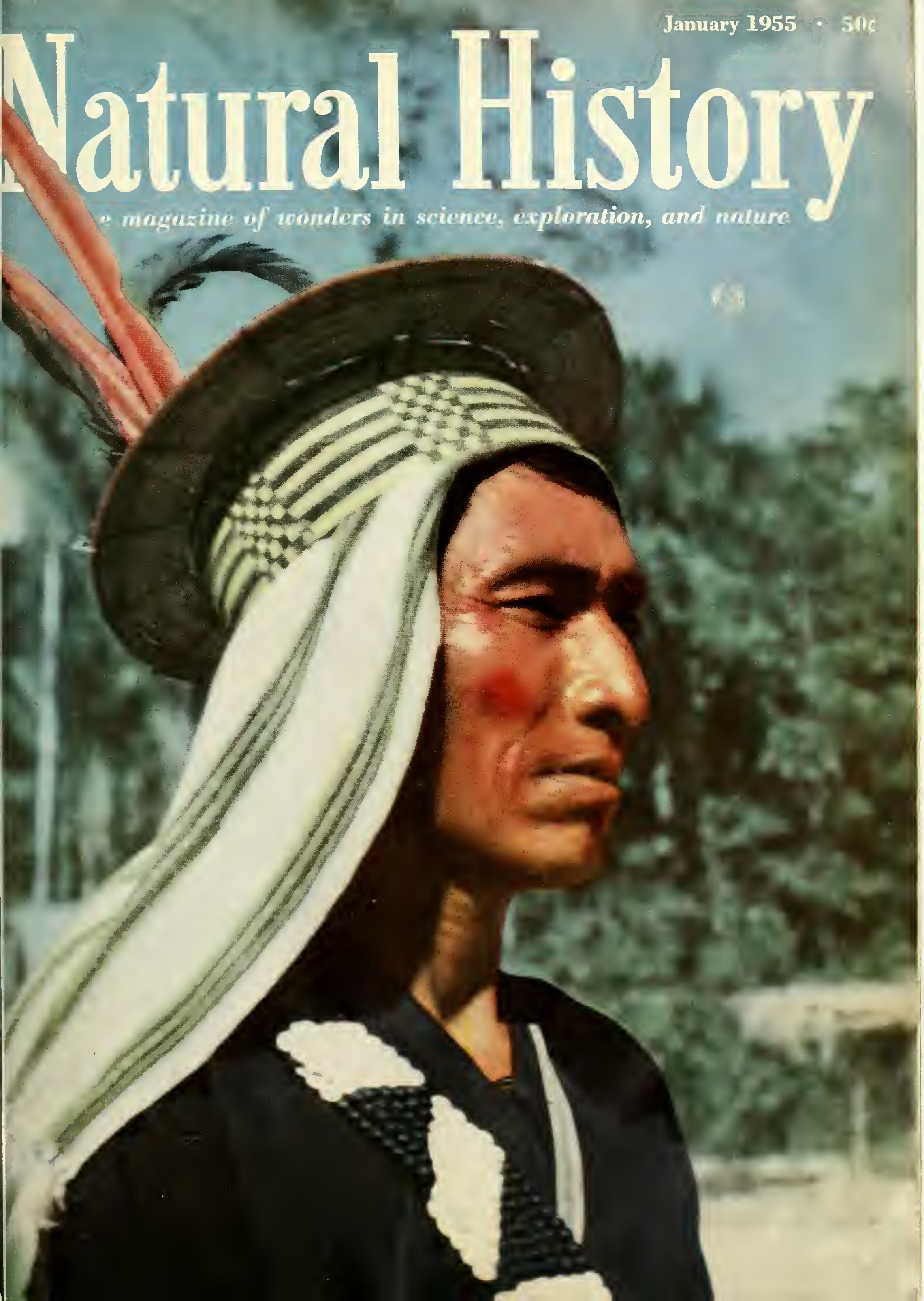

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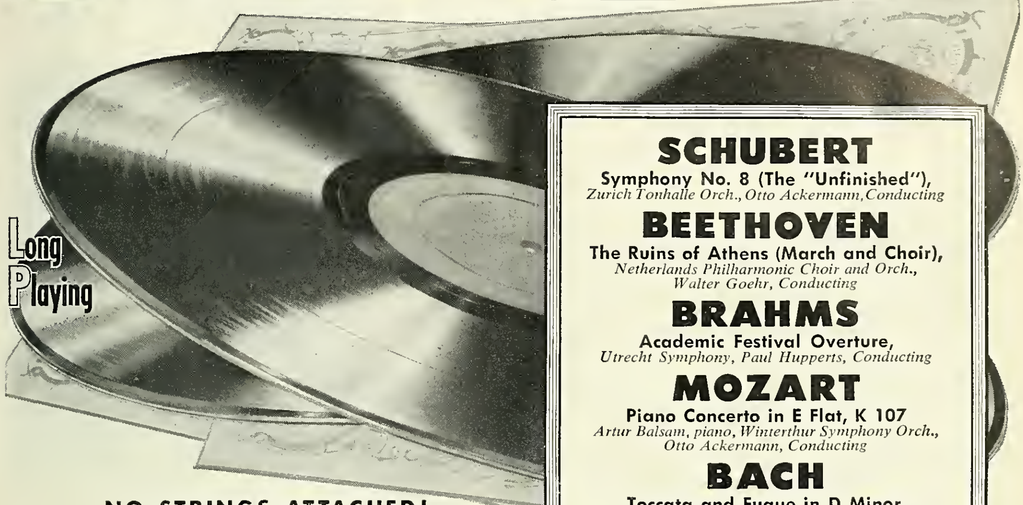

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Zurich Tonhalle Orch., Otto Ackermann, Conducting

BEETHOVEN
The Ruins of Athens (March and Choir),
Netherlands Philharmonic Choir and Orch., Walter Goehr, Conducting

BRAHMS
Academic Festival Overture,
Utrecht Symphony, Paul Hupperts, Conducting

MOZART
Piano Concerto in E Flat, K 107
Artur Balsam, piano, Winterthur Symphony Orch., Otto Ackermann, Conducting

BACH
Toccata and Fugue in D Minor,
Alexander Schreiner at the Organ of the Tabernacle Salt Lake City

WAGNER
Die Meistersinger, Prelude, Act 1
Zurich Tonhalle Orch., Otto Ackermann, Conducting

DUKAS
Sorcerer's Apprentice
Utrecht Symphony, Paul Hupperts, Conducting

MOUSSORGSKY
Night on Bald Mountain
Netherlands Philharmonic, Walter Goehr, Conducting

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January, 1955 Volume LXIV, No. 1

Campa Indian ... Cover Design
From a color transparency by Harry Tschopik, Jr.

Your New Books ... 4

Filming Jungle Fishermen ... Harry Tschopik, Jr. 8
Tropical storms and an elusive cast of characters made it difficult to find and film a colorful and little-known tribe of jungle Indians in Peru

Petrified Lightning ... Margaret Romer 18
If you see something that looks like a glass root sticking out of a sand bank, remove it gently

The Devils Postpile ... Richard J. Hartesveldt 20
These spectacular columns speak of the remarkable behavior of a lake of lava and a great glacier

Crack-in-the-Rock ... William B. Sanborn 25
A prehistoric ghost town with a daring approach

Proverbs in Ivory ... Lee Boltin and Ferdinand Okada 28
A photo series on the tiny Okimono ivory corvings of Japan

Clothes Make the Eskimo ... Vilhjalmur Stefansson 32
The air-capture system of heat control was the discovery by which the Eskimo learned to work outdoors in comfort with only one loose garment covering his naked body

Kruger's Animal Fair ... Peter Holz 42
Many South African animals would have become virtually extinct without this remarkable game sanctuary, now celebrating its 50th anniversary

Desert Dwellers — Inside and Out ... Charles Franklin Parker and Charles A. Leake 48
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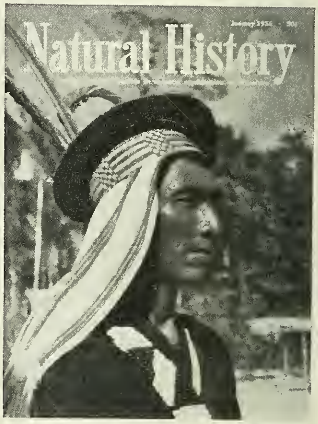

THE COVER THIS MONTH

The Indian shown on this month's cover is Toli, a chief of the Campa tribe, which is described in an article in this issue. The tribe inhabits the rain forest along the Upper Ucayali River, a tributary of the Amazon, in eastern Peru. Under a bamboo diadem adorned with macaw plumes, he wears a hand-woven cotton hood trimmed with parrot feathers, and a cotton tunic or *cushma*. His bandoleer is of seeds native to the region. Like all Campas, his face is smeared with *achiote*, a paint prepared from the berries of a cultivated shrub, *Bixa orellana*.

The homeland of the Campas is an extensive tract of high jungle called the Gran Pajonál, which lies to the west of the Ucayali between the Pachitea and Tambo Rivers. The Campas were only subdued, and their territory opened to white settlement, as recently as 1942. Much of this region is still very poorly known, and it is likely that there are Campa groups who even today have had little or no contact with the white man.

This color photograph was made in 1953 by Dr. Harry Tschopik, Jr., of the American Museum's scientific staff.

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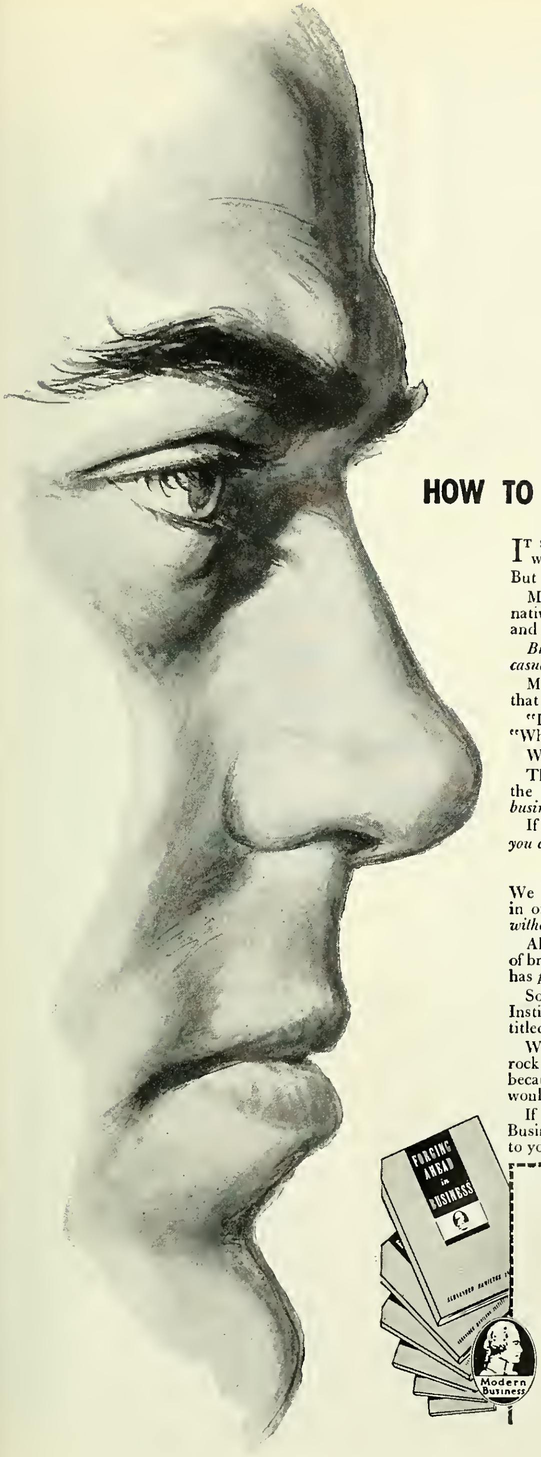
The American Museum is open to the public every day in the year without charge



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YOUR NEW BOOKS

Story of Man • Animal Tracks • Thoreau
Roy Chapman Andrews: Beyond Adventure • Insects

THE STORY OF MAN
From the First Human to
Primitive Culture and Beyond

- - - - - - - - by Carleton S. Coon

Line drawings by Richard Albany
Photographs by Reuben Goldberg

Alfred A. Knopf, $6.75
437 pp., 32 photographs, 54 drawings,
10 maps.

PERHAPS, if one were forced to select but a single popular book dealing with the evolution of man and his culture from the bitter beginnings to the present day, this would be the book. It contains an immense amount of information, is written with clarity and style, and in addition is handsomely illustrated.

Indeed, it seems unlikely that many anthropologists today could write, or would be willing to write, a book that covers the time span of 50,000 years and the total range of human development, both biological and cultural. Like everyone else, an anthropologist likes to be right, and it is impossible to be always (or even usually) right in so complex a synthesis of human history. At every turn the author must make interpretations or generalizations with which some specialist or other will find fault. Yet Dr. Coon has had the courage to assemble bits and pieces from the entire field of anthropology, plus pertinent data from history, sociology, and economics, into a highly original picture of man's development that both makes sense and is fascinating reading.

The book's central theme is that man has been converting energy into social structure at an ever-increasing pace: "As he has drawn more and more energy from the earth's storehouse he has organized himself into institutions of increasing size and complexity."

Although Dr. Coon traces man's development from apes to atoms, half the book deals with his accomplishments prior to the Bronze Age and recorded history. Perhaps the most noteworthy portions of the book are the author's ingenious reconstructions of man's social and religious life in prehistoric times. These are based upon the study of archaeological remains, the observed habits of apes and monkeys, upon the customs of the most primitive living humans, and upon a generous measure of intuition. They probably represent, however, as much as will ever be known about human society before the dawn of writing.

The maps and line drawings are adequate, and the photographs exceptional.

Harry Tschopik, Jr.

Members of the
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are cordially invited to attend an
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by
William Robinson Leigh
"Eight Decades In Review"
January 11-29, 1955
Grand Central Art Galleries
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Grand Central Terminal New York
Opening day tea January 11, 3 to 6 P.M.

BEYOND ADVENTURE

- - - - by Roy Chapman Andrews

Little, Brown & Co. and
Duell, Sloan and Pearce, $3.75
244 pp.

IN *Beyond Adventure* the gods of nature make their medicine, and before them dance all true believers in the things that have been and still must be. Roy Chapman Andrews tells about Robert E. Peary, Carl E. Akeley, and himself as three friends who discovered, for the world to see, that true adventure is an intellectual experience. Often the attainment of a quest produces dramatizations of resourcefulness and courage. Back of these are qualities of dedication to ideals.

The fixing of the invisible axle upon which the great earth turns by Peary; the realistic recording of the elephant (and indeed all of Africa) through taxidermy, motion pictures, and sculptural art by Akeley; the youthful observations of Leviathan, the blue whale in Arctic seas, adult excavation of Baluchitherium, greatest land monster that ever lived, the finding of petrified dinosaur eggs in their secular nest by Andrews—all this is more than physical triumph over obstacles. Indeed, it is visualization of the universe for the child in school and the man in the street—lest they forget!

Indirectly or directly, these three men had much to do with the American Museum of Natural History. Peary's contact was through Morris K. Jessup, an organizer of that human institution and patron of philanthropic science as a modern Maecenas. Peary discovered and brought back the Greenland meteorites.

One notes the affectionate care with which Andrews straightens out the matter of discovering the imaginary pole on floating ice and his discriminating defense of Peary against Cook.

Men who write books hope to get them read. Men who arrange museum exhibits, consisting of model groups and dioramas, are sure they will be seen. Thus, they set forth their facts with atmosphere and meticulous detail, for their public is vastly larger than that of most books. Explorers, having gathered knowledge at the ends of the earth introduce it directly into the social and educational blood stream through the medium of exhibits. Their efforts add to the understanding of nations on quite a different plane than other institutions, which are geared to a competitive economy.

Natural history museums are public utilities to be developed while unnatural living spreads in great cities. The ideal of common knowledge and effective recreation for young and old needs the validations of experience under men who have served beyond adventure.

Herbert J. Spinden

A FIELD GUIDE TO ANIMAL TRACKS

- - - - - - - - by Olaus J. Murie

Houghton Mifflin Co., $3.75, 374 pp.,
Over 1000 illus.

THIS latest addition to the Peterson Field Guide Series is one of the best, for it adds to the factual data required by a Field Guide by giving a great store of incidents and observations drafted from the wide experience of the author. Dr. Murie has spent many years in the wilderness areas of North America; he is a keen observer, and he has the ability to record precisely as an artist. Add to this a great love of natural history, a sympathetic understanding of the behavior of animals, and the patience to devote long hours to any study he undertakes, and it is difficult to imagine anyone more competent to undertake a work of this sort.

The subject matter is arranged systematically and is supplemented by over 1000 illustrations. There is a key to tracks in the introductory section, with drawings, size in inches, and page references. In many cases users of this book can run down an identification quickly by use of the key. A chapter "What Has Happened Here" gives hints on the use of the book, interpretation of "sign," how to preserve tracks, et cetera.

Mammals are then treated by families, with sketches of the animals themselves, their tracks (forefoot and hind foot), their stride, and their scats (droppings). There is a brief description of the mammal, its geographical range, its food habits, and anything else of special significance. Usually there is some anecdote or comment based upon the author's field experience to brighten up the statistical summary.

This is a multi-purpose book. It is obviously valuable for identification of tracks; it is also a concise reference for identification of the mammals themselves, and finally it is a book to read for sheer enjoyment at home for the sake of the personal narrative.

Oh yes, the book includes tracks of birds, insects, and just twigs and limbs.

Harold E. Anthony

WINGS.
INSECTS—BIRDS—MEN

- - - - - - - - by Blanche Stillson

Drawings by Kenneth Gosner.
The Bobbs-Merrill Company, Inc., $3.50
299 pp., 18 drawings.

WINGS is a fascinating collation of facts pertaining to flight in nature, which should appeal to all who are interested in natural history or aviation. Flight has long intrigued man for its expressions of beauty and freedom and for its inherent qualities of adventure. Advancing through time from the remote past, the reader is carried forward on the wings of varied and extraordinary creatures. He reads of dragonflies with colossal wings, of flight organs designed for propulsion, protection, and adornment—embellishments, which flourished millions of generations ago or which amaze us today when we inquire into the modes by which nature has mastered flight. Wings emerge from crumpled wads of membranes as masters of speed or static flight. Wings grow seemingly at will, as in the extraordinary aphids. Wings send forth such sweet notes that they are kept as bedside minstrels. The reader reads of wings both delicate and lavish, embodying cryptic designs to ward off enemies or giving off color waves invisible to human eyes; of wings of crumbling fragility, yet carrying their owners from continent to continent; of elite masterpieces of design—bird wings—developed over countless years from the forelimb of reptiles, then sometimes lost to flightlessness and gigantism, as in the bird that stood ten times as high as the horse of its day. And in endless Edens of flight developing again and again till one expects wings to sprout from every outlandish form, be it beetle, pelican, hummingbird, or flying fox. For we see it in all varities, slow, incredibly fast, embracing endurance and bizarre movements, as in the dive bombing courtship of a hummer when it develops wing beats of 200 per second.

This most interesting book is documented and indexed with care so that the reader can examine the author's sources on any particularly interesting or controversial point. For example, as when he reads of the almost unbelievable flight of a little brown bat, reported to have flown through an electric fan revolving at 800 revolutions a minute.

Beginning with techniques explored by falconers and pioneered by students like Leonardo da Vinci, Miss Stillson presents a colorful history of the quest that culminates in man's mastery of the air. Evolutionary experiments comparable to those that exacted a heavy toll among the flying animals also plagued the men who pioneered in flying, but they ultimately emerged with power to outfly the eagle. Blanche Stillson has created a classic, which does for the air around us what Rachel Carson has done for the sea.

E. T. Gilliard

FREAKS AND MARVELS OF INSECT LIFE

- - - - - - - - - - - by Harold Bastin

A. A. Wyn, Inc., $3.75
248 pp., 20 plates, 25 line drawings

LIKE all writers who attempt to familiarize young and old with the amazing oddities of the insect world, Mr. Bastin admits that he is only scratching the surface. Nevertheless, he covers the field rather adequately, beginning with the structure and life histories of insects, and properly explaining the difference between "complete" and "incomplete" metamorphosis; in complete metamorphosis, the adult insect bears no resemblance to the caterpillar, grub, or maggot of a butterfly, beetle, or fly; in incomplete, the young closely resembles the adult even

continued on page 56

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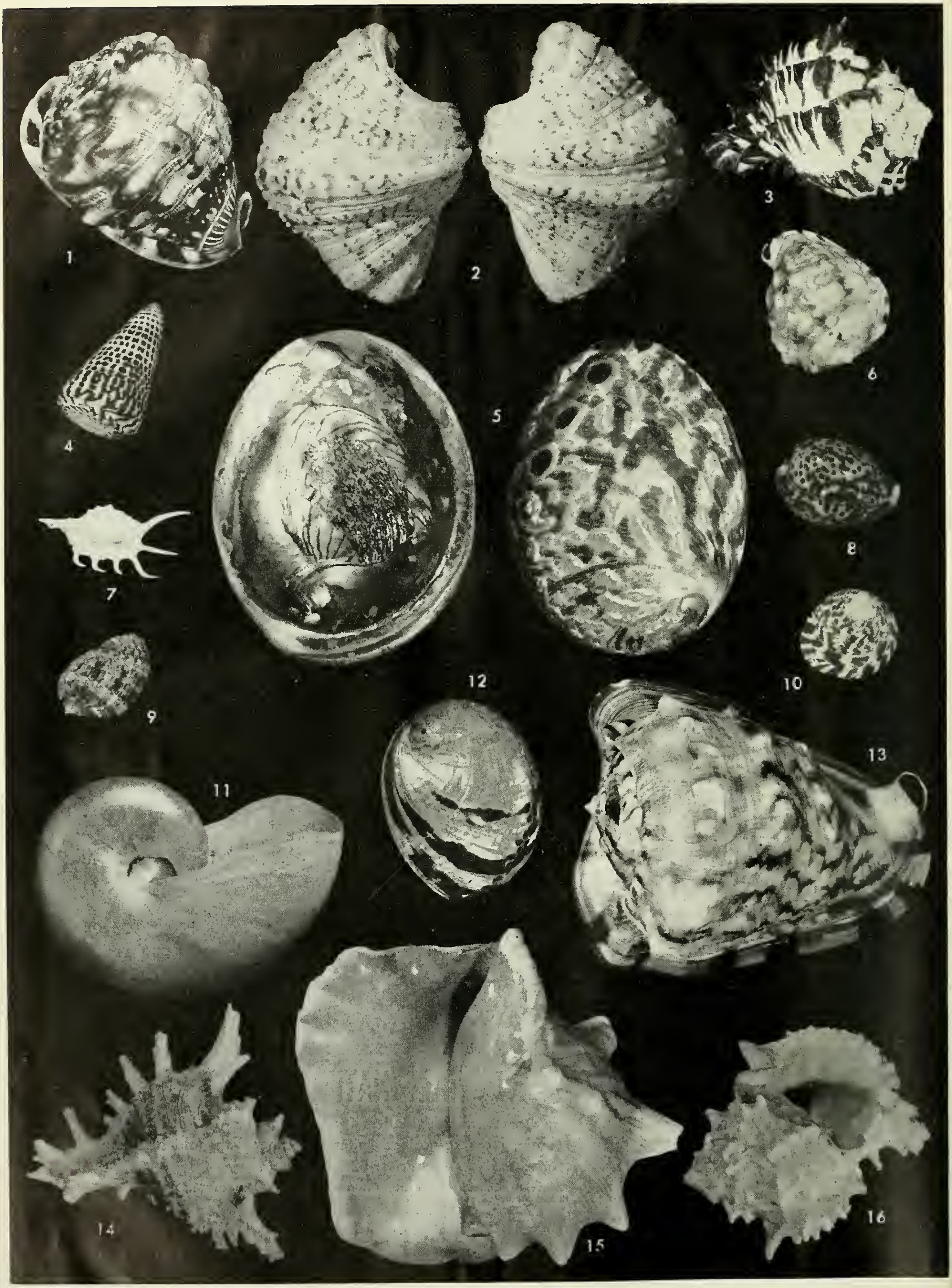
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SHELLS from the SEVEN SEAS

HAVE you ever had "shell fever"? It is a very contagious enthusiasm that is currently reaching epidemic proportions. People by the thousands are discovering the limitless variety, beauty, and fascination of shells. Collectors are using them to decorate shelves, desks, tables, and mantels and introducing them into rock gardens and table flower arrangements.

The Museum Shop is able to offer some of the most attractive shells at reasonable prices. The printed descriptions below will assist you in making your selection. Please remember that shells are produced by nature, not by man, and their availability varies greatly from time to time. We cannot guarantee that all of the shells offered here will remain in supply more than two or three months. The selected best specimens from our stock will be sent to our mail order customers in the order requests are received.

1. CAMEO *(Cassis rufa)*—Zanzibar. This is a handsome shell that has been admired for centuries. A hard and solid shell with a knobby surface, interestingly marked with shades of pink and dark reddish-brown. Has long been collected and carved into cameos and other art figures. Choice specimens, 5 to 6 inches. $1.75 plus 25¢ postage.
2. CHINESE CLAM *(Hippopus maculatus)*—Philippine Islands. This is a large bivalve from the far Pacific. The two valves are shown separated here. You may prefer to show this shell with the two valves together. Deeply serrated edges meet and close in a most interesting manner. The ground color is ivory with a mottled pattern of dark red spots. 6 to 8 inches. Unusually low price: $1.75 plus 35¢ postage.
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5. PRINCESS' HELMET *(Cassis flammea)* — West Indies. This is a beautiful shell, with a rippled pattern of soft brown and tan markings on a white background. Sturdy, very clean-cut, with a high natural gloss. About 4 inches. 85¢ plus 20¢ postage.
6. ORANGE SCORPION *(Pterocera aurantia)* — Philippine Islands. An odd shell, with long hooked spines. Largely white, but the aperture is a brilliant pink or orange. About 4 inches. 60¢ plus 15¢ postage.
7. POLISHED ABALONE—West Coast. Dramatically beautiful! The inside (left) of the shell is a blaze of iridescent colors, while the outside has been polished down to the surface, revealing a breathtaking kaleidoscope of rich red and ivory mother-of-pearl, or peacock green and ivory, depending on the type preferred. This is Nature in one of her most lavish moods, imperishably recorded for your enjoyment. Superbly ornamental—and useful as a candy dish. The red type runs 7 to 9 inches in length, the green 6 to 8 inches. Specify color desired. Only $3.00 each, plus 30¢ postage.

   UNPOLISHED ABALONE. The red abalone is available without the polished exterior surface. The inside is as described above, but the outside is left natural. $1.00 each, plus 25¢ postage.
8. TIGER COWRY *(Cypraea tigris)* — Australia. A popular shell; hundreds of thousands have been sold. Strong, smooth, with a natural high polish. The vague brown spots are scattered around in a field of pink and gray, though it is hard to describe because the variation is great. Many people like to collect them for this reason. 3 inches or larger. 25¢ plus 15¢ postage.
9. HARPA CONOIDALIS—Mauritius. This shell is greatly admired for its clear-cut, exquisite form, marbleized pattern of white and reddish brown, and prominent ridges arranged in a rhythmic swirl. The surface is naturally lustrous. Must be seen to be appreciated. About 3½ inches. $1.75 plus 15¢ postage.
10. PEARL TROCHUS *(Trochus niloticus)* — East Indies. Shaped like a youngster's spinning top, this is another shell known to millions. Very interesting and attractive in its natural state, as shown here, with the ivory pattern of slate green against white circling its conical shape. About 2 inches high. 45¢ plus 15¢ postage.
11. PEARLY (OR CHAMBERED) NAUTILUS *(Nautilus pompileus)*—East Indies. This is the Chambered Nautilus of Oliver Wendell Holmes' poem, and well deserving of its fame. As shown, the outer surface has been polished down to pearl, which shimmers with faint bands of iridescent blue, green, pink. Sometimes made into attractive lamps, flower holders, etc. Good specimens, about 5½ inches. $3.00 plus 25¢ postage.
12. POLISHED BLACK ABALONE *(Haliotis cracherodi)*—Pacific Coast. A smaller abalone, which has the customary beautiful, iridescent lining. The outer side, as shown, has been highly polished to the gleaming black and white pearl. A very neat and handsome shell at a very low price in view of the labor involved in polishing. About 4½ inches. 75¢ plus 15¢ postage.
13. KING'S HELMET *(Cassis tuberosa)*—West Indies. A large shell of regal appearance, rich in color, form, and design. Muted shades of tan, pink and brown blend over the entire surface with bolder markings near the edges. It is an arresting shell from any angle. It is seen from the top here. The underside, or face, is even more dramatic: triangular in shape, glossy, predominantly pink with strong white and brown lines, and very realistic "teeth" at the edge of the aperture. Good specimens, 7 to 8 inches. $3.25 plus 40¢ postage.
14. WHITE MUREX *(Murex ramosus)*—Red Sea. An exotic shell of striking appearance. The surface is mostly white, occasionally with touches of pink or brown, and there are numerous long spines, which give it a most decorative silhouette. This shell is very attractive by itself or in flower arrangements. About 5 inches. 75¢ plus 20¢ postage.
15. PINK CONCH *(Strombus gigas)*—West Indies. Here is a shell known and loved all over the United States. Who hasn't "listened to the sea" with one of them? The specimens we have are excellent ones. The aperture is an unusually deep glossy pink. Museum visitors are delighted when they see these shells in The Museum Shop, and at a special low price—less than they usually bring at the source! 8 to 10 inches. $1.25 plus 35¢ postage.
16. ROSE MUREX *(Murex regius)*—Panama. Another pretty Murex, notable for the smooth and deep pink aperture, which contrasts with the knobby white exterior. About 4½ inches. 85¢ plus 20¢ postage.

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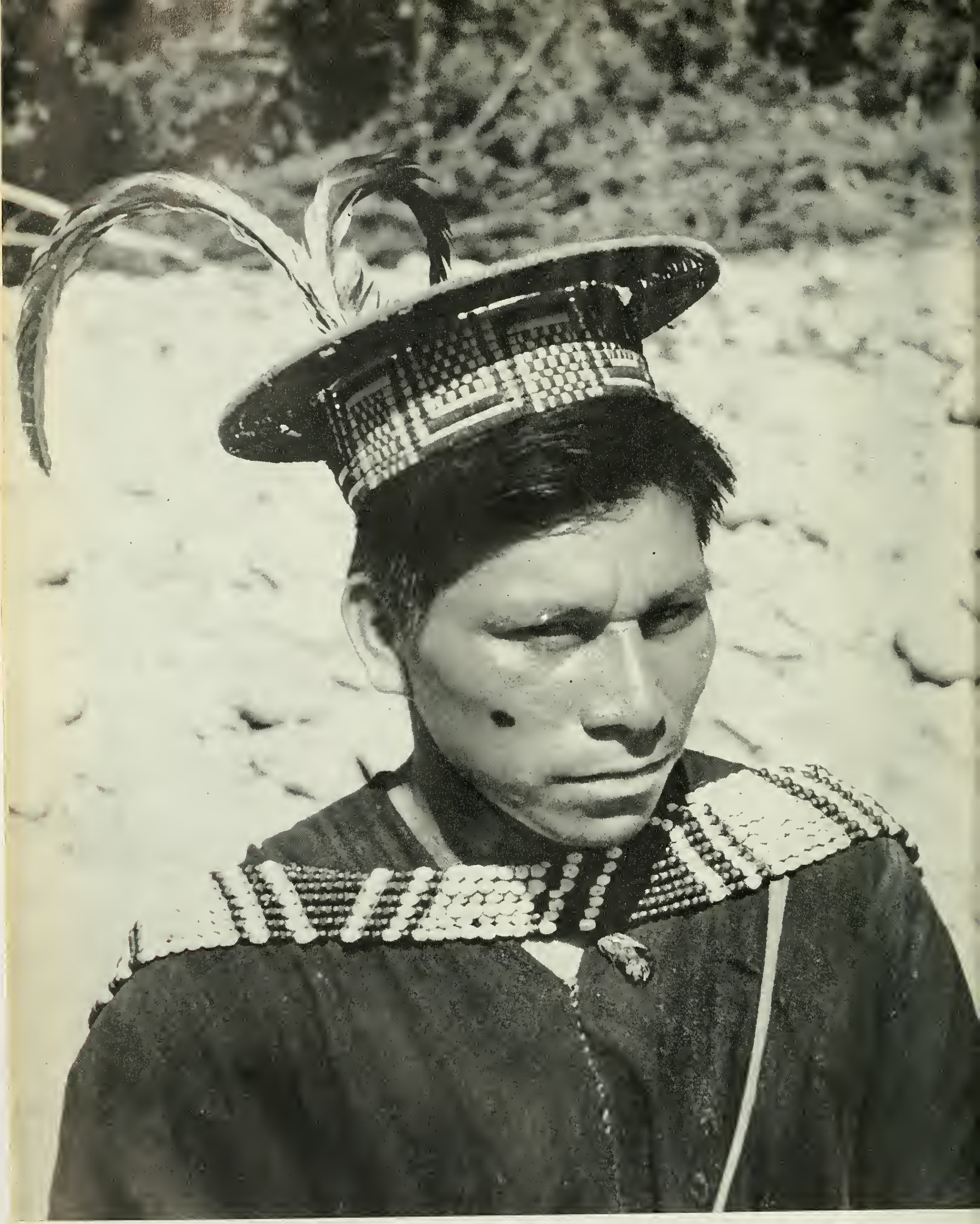
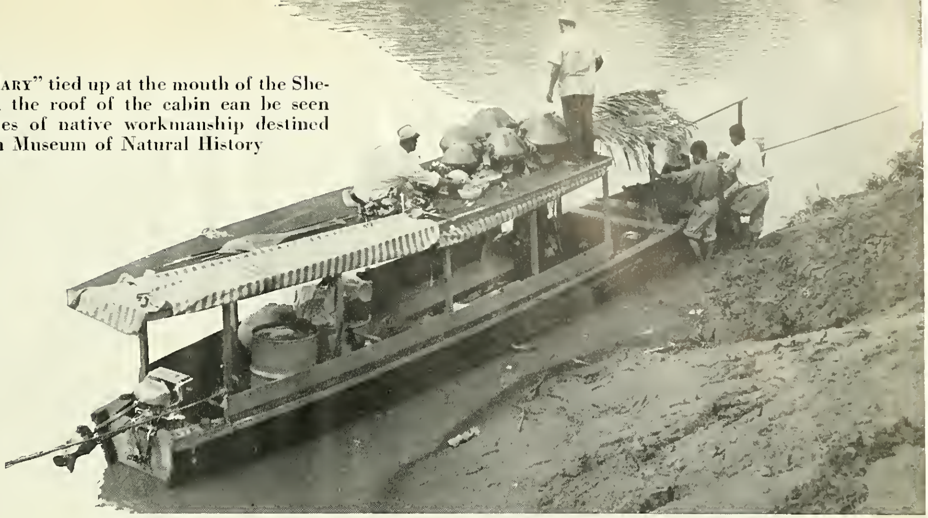


▲ AT FIRST, Ingeri distrusted the anthropologist's motives in coming to the Campas' domain. Later, won over by the magic of the tape recorder, he became a star performer in the documentary motion picture

➤ The "Queen Mary" tied up at the mouth of the Shehuaya River. On the roof of the cabin can be seen out-sized examples of native workmanship destined for the American Museum of Natural History



Filming Jungle Fishermen

Tropical storms and an elusive cast of characters made it difficult to produce a scientific motion picture of a little-known tribe of forest Indians in Peru

By Harry Tschopik, Jr.

All photographs by the author

A FLASH of lightning tore the darkness of the clearing, and close upon the deafening clap of thunder came a noise like a drum roll surging down through the jungle-covered foothills of the Peruvian Andes, announcing the approaching downpour. Soon large stinging drops of cold water were pelting us.

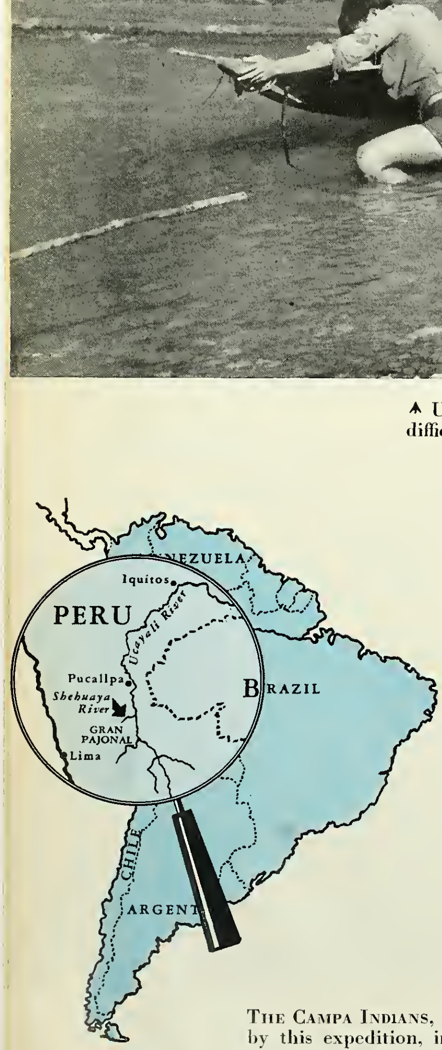
This would mean even more delay, for though we had chosen the dry season to make our way up the Shehuaya River to film the life of the Campa Indians, the elements seemed to have conspired against our plan. Indeed, there had been unprecedented rains ever since I had arrived five months before in Pucallpa on the Ucayali River. The swollen streams had made travel impossible in some sections, and we had had to abandon plans to investigate several important areas near where the Ucayali joins the main stream of the Amazon. The rains had driven many Indian groups deep into the forest. The Campas, whom we now sought, had never been described scientifically, much less recorded on motion picture film.

Gustavo, our Conibo Indian pilot, presented me to a short, thickset Indian with heavy bangs hanging to his eyebrows: "This is Pancho, my uncle. Beyond here, we shall meet no more Conibos—only Campas." He sneered. The Conibo and Campa tribesmen had been bitter enemies as long as anyone could remember.

Our launch, the "Queen Mary de Amazonas," lay well moored at the river's edge below, but the storm now broke in full fury and the rain roared down in solid sheets.

"Let's run for it," shouted de los Ríos, my Peruvian companion. The boys were bringing up our baggage and cameras, so we took off on the run for a large thatched house 100 yards away. We reached it soaked to the skin. Outside, the rain was a shining curtain, brilliantly lighted by flash after flash of lightning. The great trees

▲ Up the Shehuaya River, submerged logs and rocky bars made canoe travel difficult. The rivers, not the jungle trails, are the roadways of the Upper Amazon



The Campa Indians, filmed for the first time by this expedition, inhabit a region on the eastern slopes of the Andes in central Peru

groaned and creaked as they swayed before the wind. In the distance, with a noise like gunfire, the roots of a forest giant snapped one by one, and with a splintering rumble like the noise of an earthquake, the huge tree, carrying with it tons of earth, slid into the river.

I was sitting in my mosquito net in the darkened house, reflecting sadly on the obstacles to our plan, when I heard de los Ríos say, "Cheer up! Just remember that ten years ago you wouldn't have photographed the Campas, rain or no rain. In all probability, you'd have been dodging arrows. Did I ever tell you that when we lived on the Rio Tambo, my wife and a servant girl were besieged by Campa warriors for over a week? Everyone was terrified of the Campas in those days. Why, only three years ago, a raiding party came out to the main stream of the Ucayali and massacred the passengers and crew of a large river steamer that was tied up for the night."

"Let's hope, then, that the Campas are worth waiting for," I said.

"Yes, they are really *bravo* Indians, yet they are somehow noble."

De los Ríos was a romanticist, and he loved blood and thunder.

By morning, the rain had stopped. The debris-littered waters of the Shehuaya were pouring into the Ucayali like bath water down a drain, but the sky was clear and cloudless.

In a kitchen shed in the clearing, the Conibo women were baking plantains and broiling fish for breakfast. Blue and yellow macaws in noisy twosomes were flying high above to their feeding trees deep in the forest. Small monkeys gibbered and chattered as they brazenly stole fruit from the banana groves within sight of the house.

De los Ríos and I breakfasted on the high clay bank, watching the water in the gorge recede with unbelievable rapidity. The "Queen Mary" had been moved out into midstream where she would not go aground. Already the water was so clear that the white pebbles on the bottom gleamed in the sunshine.

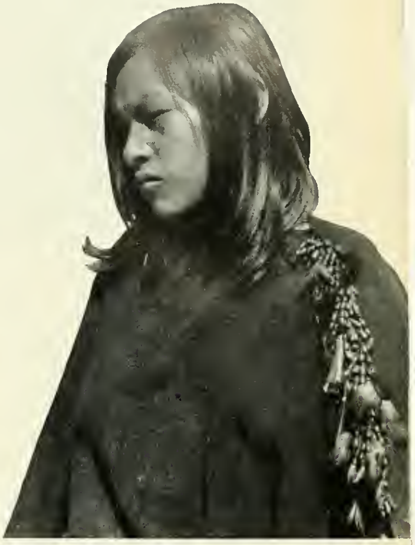
Suddenly, upstream, a canoe glided out from behind a hanging curtain of lianas and headed in our direction. A man standing in the bow waved his hat.

"*Hola*, Orihuela!" yelled de los Ríos, clambering down to the water's edge.

So we were not to be delayed after all. Pepe Orihuela and his attractive wife, Mercedes, had arrived—like the proverbial Marines—to our rescue. I had met them months earlier in Pucallpa, where they had invited us to visit their plantation on the Shehuaya and had offered to take us in to the Campas. As much as anything else, I was interested to see how they lived—two civilized young Peruvians who had abandoned an easy existence in metropolitan Lima to make a new life for themselves on the jungle frontier. Except for the recently hostile Campas, their nearest neighbors were two days away by motor launch.

But while we drank coffee and de los Ríos briefed the Orihuelas on the latest news from the outside world, I couldn't keep from staring at the other occupants of the canoe. The first sight of a crocodile sunning itself on its native sand bar is thrilling. So is one's first glimpse of wild orchids cascading down the mossy branch of a tree. But these are nothing compared to the sensation of meeting Indians as yet untouched by the white man's ways.

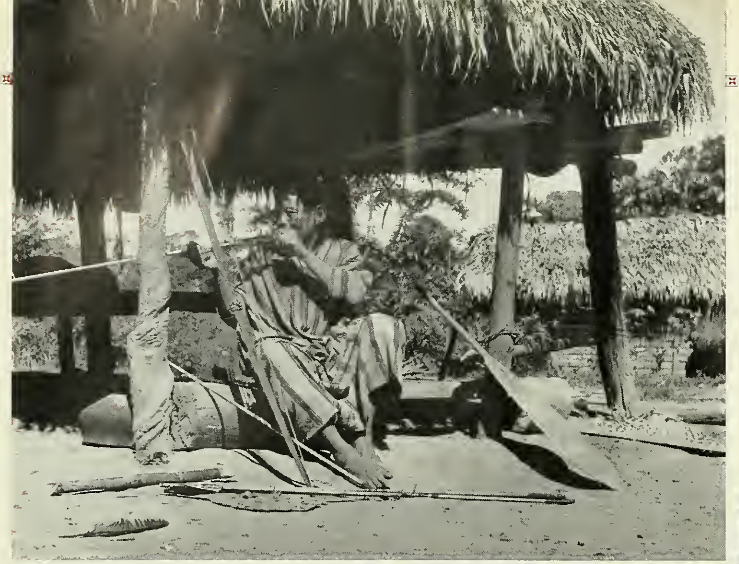
There were three Campas, a man, a woman, and a small chubby infant. The man, whom Orihuela introduced as Ingeri, his foreman, was short but strongly built. His face, tattooed with fine blue-black lines, was entirely smeared with brilliant red paint. On his short-cropped hair he wore a bamboo crown, like an inverted straw hat minus the top. Two long feathers



▲ THE COTTON DRESSES woven by the Campa women are decorated with seeds, nuts, feathers, bird scalps, and colorful toucan beaks. One woman adorned her latest model with the cast-off brass shell cases from the author's rifle

▼ THE ORIHUELAS' establishment at San José de Shehuaya. Although primitive in appearance, the thatched house, with its open sides and overhanging eaves, is well suited to the tropical environment

▼ THE HOUSES of the Campa Indians afford little protection from the torrential downpours of the Upper Ucayali region, but the semimigratory nature of their life prevents these Indians from building more durable homes. The wooden trough inside is used in the preparation of manioc beer



◄ **THE CANE AND HARDWOOD ARROWS** of the Campas are among the best produced in the Amazon Basin. The spiral placing of the feathers ensures accuracy at long range

▼ **PREPARATIONS** for the filming: a view of the fishing camp that was established on an island in the Aruya River, a tributary of the Shehuaya. The roomy mosquito nets of thin woven cotton are a native Amazonian invention

were stuck in the back at a rakish angle. His body was covered by a coarse brown cotton *cushma*, smeared with red paint. Over his shoulders he wore a bandoleer of black and white seeds. He carried a bow and several beautiful but ferocious-looking arrows. When introduced, he nodded sullenly but did not offer to shake hands.

The woman, his wife, smiled briefly at the ground, and then looked away over the river. She was a slim, handsome girl of about sixteen, dressed in a brown cotton tunic decorated with wild seeds and toucan scalps. Over her shoulder she carried a sling to which a number of incised bone rattles were sewn. In the sling sat the fat baby, playing with the rattles. His painted face alone wore a broad, friendly grin.

An ethnologist by profession, I am a photographer at heart. But the cameras would have to wait until I knew the Campas better.

Orihuela stood up. "The Shehuaya is too shallow for the 'Queen Mary,'" he said, "and many trees are down across the river. But I think we can make it in two dugout canoes."

While de los Ríos negotiated to rent a second canoe from the Conibos, Gustavo and our other Indians began to load the baggage. Only the most necessary equipment — medicines, photographic supplies, tape recorder, bedding, and guns—could be taken into the interior. Gustavo and two other Conibos would accompany us as boatmen. The rest of the crew would stay behind with the launch.

By mid-morning we had left the Conibo settlement on the Ucayali and were headed up the Shehuaya gorge. We had left behind the thickets of *caña brava* with their waving purple plumes and saw-toothed leaves, and were entering a high gallery forest of tropical hardwoods, laced together by a network of flowering lianas and shining green philodendrons. The numerous fingers of the river, separated from one another by jungle-covered spurs and islands, reached westward into the forests and savannas of the Gran Pajonal—the traditional homeland of the Campas. The gradient was steep, and at times we made little headway against the current. Now and then the Indians waded waist-deep in the stream, straining to push the heavily laden canoes over submerged boulders and logs.

Rounding a bend, the river divided into two smaller streams of almost equal width. Here the banks rose sharply, and abrupt hills loomed in the distance. Green water hissed over the rocks and among the debris from the last storm. Here we unloaded the canoes so the Indians could pole and drag them over the rapids of the right-hand channel. No sooner were the dugouts reloaded than it was necessary to remove everything again in order to pass the canoes under a huge fallen tree.

The gorge became narrower and

the trees arched together overhead, shutting out the sky. A large iridescent blue butterfly flitted down the gloomy tunnel, and ahead of us a sleek otter slid into the water. There were no houses, no signs of human habitation. After the oppressive heat of the main stream, the jungle tunnel was as cool as an air-conditioned room.

Toward late afternoon the gloom increased and, without warning, rain deluged through the canopy above. We beached the canoes, covered the baggage with canvas, and bailed like crazy to keep the equipment dry. When we were half drowned, the rain stopped abruptly, and shafts of sunlight shot through the leaves. We didn't bother to get back into the dugouts, but sloshed ahead up the stream bed for a mile or more. Just at sunset, the river widened and blue sky broke through overhead. In the distance, smoke drifted on the still air. Pepe Orihuela removed his dripping hat and, standing in midstream, made me a mock bow, gesturing upriver.

"Your house, Señor. We call it San José de Shehuaya."

Whoever picked the Orihuela's house site—and I suspect it was Mercedes—had an eye for drama. It would have been my choice for Rima's home in a movie version of *Green Mansions*. The house was built on a high bluff overlooking a deep pool in the river. To the right, one looked down the cool green tunnel where we had left the canoes. To the left, the broad view across jungle-covered hills was magnificent.

Behind the house stretched orderly plantations of bananas, plantains, and coffee trees, as well as fields of rice, corn, manioc, pineapples, and sugar cane. There were groves of oranges, lemons, limes, and avocados. Flowers were everywhere. Even the fruit trees sported orchid plants in full bloom, where Mercedes had placed them when she returned from walks in the forest.

Fat ducks and geese swam in the pool below, and a neat barnyard was crowded with chickens and turkeys. Beyond, great hogs and pink piglets rolled luxuriously in the mud of a pigsty. All around this man-made marvel towered virgin jungle.

The house itself was simple but sensible and built for comfort. While we relaxed over drinks in the fading light, I asked, "Tell me, Pepe, do you grow and make everything you use?"

"By no means," he replied, "but you might almost say that we live for nothing. The jungle feeds us. I employ two Indians to hunt and fish for me, and to gather wild foods from the forest. Surplus farm products buy our clothes, gasoline, tools, and other manufactured things, and we live simply. But the farming is merely incidental. I make my money in lumber, rubber, and coffee. So I say we live for nothing."

At that moment a neat servant girl announced dinner. I was totally unprepared for such a banquet. A salad of avocado and hearts of palm was followed by broiled fish and a casserole of wild doves. I ate like one of the starving Armenians, but this proved to be a mistake, because we were only

▼ THE CAMPAS are not expert canoe men like the Conibos. Traveling to and from the fishing grounds, they poled their dugouts instead of paddling them

warming up. The main dish consisted of roast peccary, or wild pig, followed by pineapple, papaya, and the Orihuela's own coffee. I could barely get up from the table.

Perhaps it was the setting, the company, and the wonderful food after a hard trip, but at that moment I never envied a man so much in my life.

Later that evening, we sat on the river bank in the heavy tropical dusk that settles suddenly, like a lid, over the jungle. Bats flitted about aimlessly, and the frogs, insects, and night birds began their noisy evening chorus.

I explained to Pepe what I wanted to film, and why—how the movie camera can capture the mood of a native ceremony, the skill of an archer, or the intricacies of weaving techniques in a way that it is all but impossible to convey with printed words. Particularly, I told him, I wanted to film how the Campas drugged their streams and shot the stupified fish. This strange method of fishing is not uncommon in the Amazon, but the Campas were said to be especially adept at it.

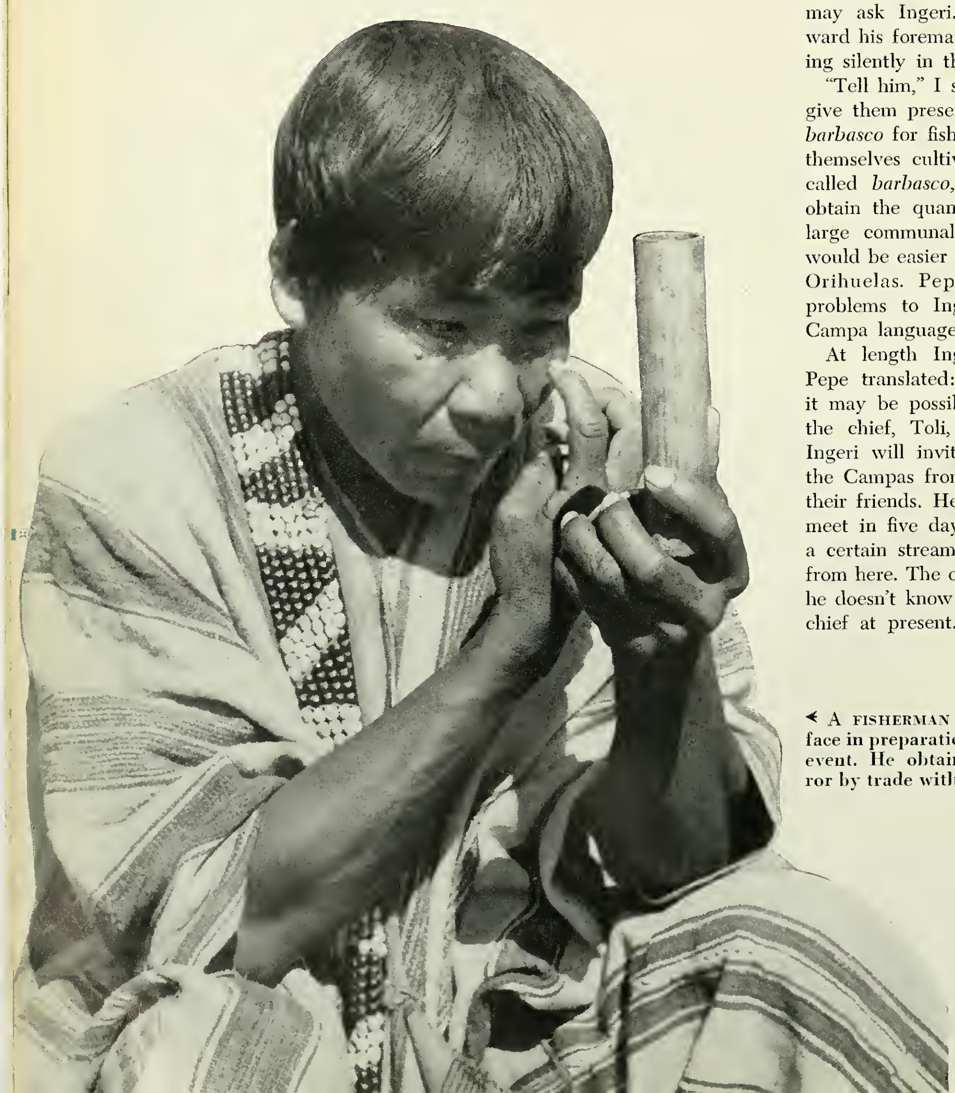
"It will be difficult," replied Pepe. "There may be as many as 15,000 Campa Indians—who knows how many?—but they live scattered in little family groups, hidden away in the hills and jungle, and because they often make war on one another, it is hard to get them together."

"How about your Campas," I asked, "the ones who work for you?"

Pepe shook his head. "I have little control over them. They come and go as they please. They may work for a week or for several months, but I can't count on them. Suddenly they just vanish. And, besides, their chief, whose name is Toli, is not very friendly. Like most of them, he is afraid that more white men will come to live in the Gran Pajonal. But if you like, we may ask Ingeri." He nodded toward his foreman, who was standing silently in the shadows.

"Tell him," I said, "that we will give them presents as well as the *barbasco* for fishing." The Campas themselves cultivate the fish drug called *barbasco*, but in order to obtain the quantity needed for a large communal fishing party, it would be easier to buy it from the Orihuelas. Pepe explained our problems to Ingeri in the rapid Campa language.

At length Ingeri nodded, and Pepe translated: "He thinks that it may be possible, provided that the chief, Toli, does not object. Ingeri will invite his people and the Campas from Aruya, who are their friends. He will tell them to meet in five days on an island in a certain stream, a day's distance from here. The only trouble is that he doesn't know where to find the chief at present."



◄ A FISHERMAN painting his face in preparation for the big event. He obtained his mirror by trade with the Conibos

It was now too late in the evening for further arrangements. Ingeri sat down on his haunches. His wife began to sing to the baby, dozing in her lap. The lullaby was soft and gentle and, with the background of forest noises, made a pleasing melody. I lighted a lantern, opened the battery-operated tape recorder, and hung the microphone on a near-by tree.

The reels began to spin. When the song ended, I rewound the tape and handed Ingeri the earphones. He listened, at first suspiciously, then with concentration. Suddenly, for the first time since we had met, he smiled. He passed the earphones to his wife. She laughed a loud, delighted laugh.

Silently, slowly, the shadows around us moved, and some twenty Campas — men, women, and children — emerged from among the trees, into the circle of lamp light.

Pepe gave me an amused glance. "Let me introduce Toli. He knew you were coming, and I was sure he wouldn't be far away."

The chief was dressed and painted like Ingeri, but instead of a crown, he wore a striped hood, trimmed with green parrot feathers. Toli spoke brusquely and with authority, pointing to the tape recorder.

"The chief would hear that machine," said Pepe. Again the tape was rewound, and I handed Toli the earphones, throwing the switch. For a minute or more he showed no expression. Slowly his lips curved in a faint smile, and he spoke again.

"He wants to know if the machine can talk," Pepe translated.

I reversed the dial to "record" while Pepe directed Toli to say something into the microphone.

A torrent of speech followed. The chief listened to the entire playback without a word. When it had finished, he stared at the earphones in baffled amazement. Suddenly he let out a roar and slapped his thighs. The other Campas joined in, laughing and shouting, and there was a fight for possession of the earphones.

In the bedlam that followed, one Indian produced a small monkey-skin drum, another a set of panpipes. Everyone sang in the loud, wild style of the Campas, and cigarettes were passed. It was past midnight when we finished recording. The prospect for movies began to look better and better.

Ingeri, as well as the chief himself, departed the next morning to invite their friends and relatives to join the fishing party. They carried with them promises of machetes, knives, and other presents, as well as news of the miraculous box that talked and sang and laughed, and did so, moreover, in the Campa language!

Meanwhile, lugging cameras, tripod, and other gear, we tramped miles through the forest, visiting the widely scattered Campa encampments, filming the Indians' preparation for the big event. The men were busily restringing their bows and making hundreds of fishing arrows. Hunters returned from the forest with their bags of monkeys, parrots, and wild pigs, which were to be smoked as provisions for the journey. The women and girls were weaving new fish baskets, and the boys were brushing up on their archery.

We were blessed with brilliant, cloudless weather, and film hummed through the camera as it recorded the Campas going about their daily activities. Ignorant of photography, they were unselfconscious. Proud and dignified by nature, they made fine actors.

On the fourth day, our luck changed. Because of the distance to the fishing grounds and the difficulty of transporting the equipment by land, our gear had been packed into canoes and sent on ahead with the Conibos. No sooner were the dugouts out of sight beyond a bend in the Shehuaya than the heavens opened and the rain came down in a roaring deluge. It rained all day and all night. On the morning of the fifth day, the rain had stopped, but heavy gray clouds blanketed the treetops.

▼ THE CAMPAS decorate their faces on every important occasion. So far as is known. the designs are purely for adornment

▼ MAKING FISH POISON by pounding *barbasco* roots. *Barbasco* furnished an important insecticide during World War II. South American Indians use more than 100 plants as fish drugs

Our route lay overland, through a low valley flanked by rocky outcrops. Wisps of mist floated among the buttresses of the trees, heightening the unearthly atmosphere of the deep rain forest. The trunks towered like the cloisters of a cathedral, and the floor, under the heavy canopy of leaves, was all but bare of vegetation.

But rain had drowned the forest. The farther down the gloomy valley we tramped, the deeper rose the water. Mud sucked at our boots and made walking all but impossible. In places the water was over our waists, and we slipped and stumbled over hidden roots. And then it began to rain again, a steady, constant downpour. At nerve-racking intervals, sodden rotten branches crashed to the forest floor. I had never known that nature could be so perverse.

It was almost dark when we heard the roar of running water and came out of the forest onto the bank of the river. This was where the fishing was to take place. Barely visible in the gloom was a long, low island. On it was what at first appeared to be a sizable village. Fires blazed from one end of the island to the other, and many figures moved back and forth in the flickering light. The Campas had arrived.

We waded the river, foam flecked and filled with swirling debris. There was no village, but the Indians had hastily erected a number of temporary lean-tos of palm leaves. They had removed their *cushmas* to keep them dry, and were sitting inside their flimsy shelters, naked and shivering. The driving rain blew in on all sides, and the fires smoked and spluttered.

In the darkness we walked through the maze of lean-tos looking for Toli and Ingeri. They stood on a sandy point, gazing upstream.

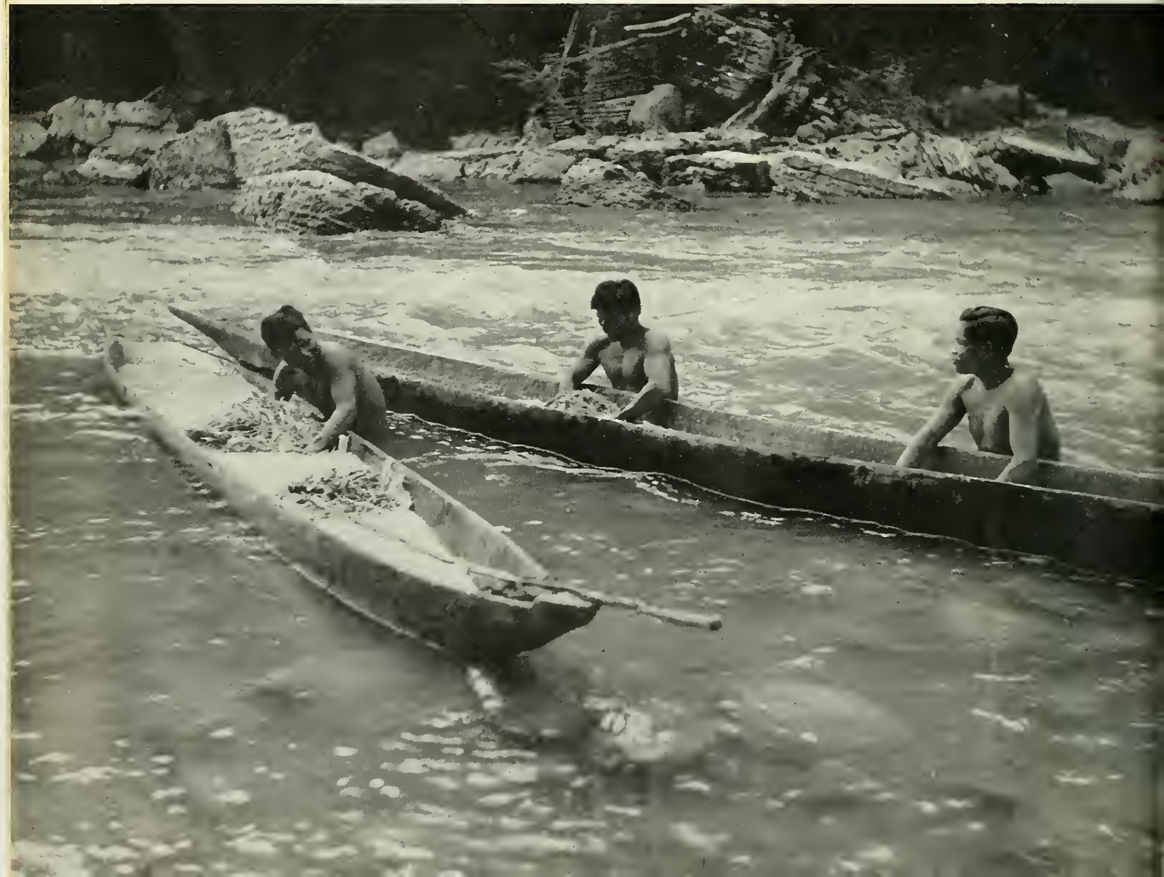
"Until the water goes down, there can be no fishing," Toli said. "With this heavy rain it may be several days."

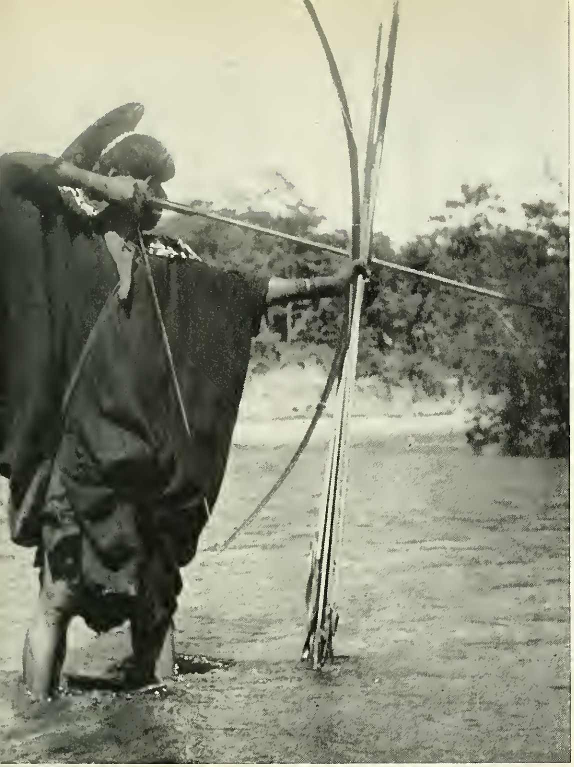
At the moment, we were more interested in shelter and shedding our wet, muddy clothes. "Where are the Conibos and the canoes?" de los Ríos asked.

"They have not come," Ingeri replied.

"What? They left yesterday morning!" Pepe was clearly worried. My heart sank. Cameras, tape

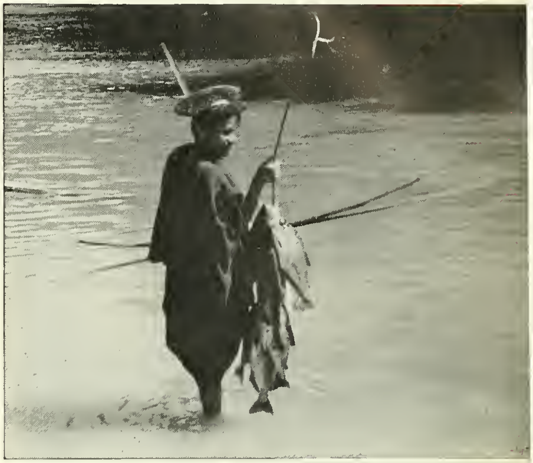
▼ THE POUNDED *Barbasco* ROOT is mixed with clay and water in canoes before being dumped into the river. In this operation, about 130 pounds of the drug were employed





◂ THE OBJECT in shooting a fish that has been drugged with *barbasco* is to prevent it from being swept downstream by the current. The swirling water usually washes the light cane arrow and the fish ashore

▾ THE FISH DRUG, *barbasco*, kills fish by paralyzing their gills so that they suffocate. It does not contaminate their flesh



recorder, tent, clothes—everything we owned was in those canoes.

We ate with the Campas but could not keep our eyes from the river. Where were the canoes? We stalked up and down the bank, staring upstream. There was only the rain and the forest. We huddled by a fire, and no one talked. My watch told me it was close to midnight.

Then came a shout from the far bank. A figure struggled and staggered across the river. It was Gustavo, and his head was cut and bleeding. While we attended to him, he told us that one canoe had struck a boulder. The bow was badly smashed, but the equipment was intact. Toli sent a detachment of Campas to carry the gear to the encampment.

It rained for three days. Everyone's disposition wore thin. Most of the provisions of the Campas' had been eaten, and they were sullen. Even the magic of the tape recorder failed to amuse them. Some wanted to go home, but Toli restrained them. There were arguments and fights between the Campas and the three Conibos.

Then the rain stopped, but threatening clouds hung low in the sky. Gradually the water subsided and became less muddy. Toli inspected the river and announced that the fishing would take place on the following day. I argued desperately that the weather was not fit for color photography and begged him to wait a day or so longer. He didn't understand, of course, but the promise of two puppies to be trained as hunting dogs finally swayed him.

The other Campas, even Ingeri, changed from sullen to belligerent. Any fool—even a white man—should know that it was more comfortable to fish under an overcast sky than in the heat of the sweltering sun. One family, defying Toli, departed in a huff. The others muttered and spat when they looked in our direction. The food situation was now critical, and Toli bluntly refused to wait longer. Tomorrow the Campas would fish, rain or shine.

The following morning was overcast, but as we ate an early breakfast, blue rents appeared here and there in the cloudy sky. The camp was a hubbub of excitement. Toli blew a horn trumpet to call the Campas together and laid out plans for the day's activities. Everyone was put to work. The boys and older men were to pound quantities of *barbasco* root. The women and girls, armed with spears and fish baskets, were sent to the rapids just above the island. Men strung their bows, collected their arrows, and painted their faces in bold red patterns. Barking dogs and small children scampered excitedly around the encampment.

With as much enthusiasm as I could muster, I cleaned the camera and oiled the tripod. De los Ríos and Pepe collected the other photographic equipment and entrusted it to the Conibos, who formed my camera crew.

And then, suddenly, the clouds parted, as if swept aside by a broom. Upstream loomed the jagged

Andean foothills, and the sun shimmered on wet green leaves. The sun and the excitement affected us all.

In our remaining good canoe we set off upstream. Archers were strung out along both banks, poised strategically on boulders and logs. The line of fishermen stretched a half mile or more. In a deep pool upriver, where the stream was confined between steep banks, naked Indians mixed *barbasco* root in canoes filled with water and clay. The clay would carry the drug to the very bottom of the river so that no fish might escape. Toli supervised this crucial operation. When he judged the time to be right, he ordered the canoes overturned.

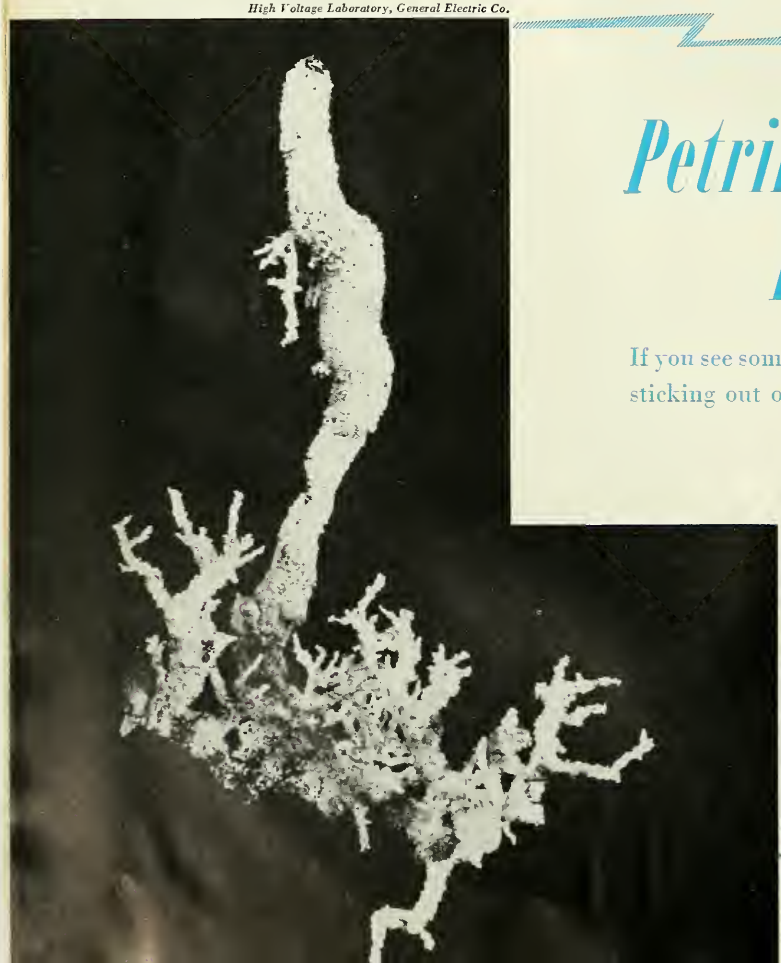
A wave of opaque yellow water swept down the river, and we followed, staring at the surface. Within minutes it was alive with flopping, gasping fish. Huge catfish floundered in the shallows. Salmon-like *sábalos* leaped, or thrashed on their sides. Terrified and drugged, the fish darted onto the very beaches. There were fish in bewildering numbers, fish of all sizes, shapes, and colors—gold and silver piranhas, striped *palometas,* spotted eels, sting-rays, and countless others.

The air was alive with the sounds of thrashing water and twanging bowstrings. Arrows rained into the river from every side. There was no time now to string the fish. They were simply hurled among the cobbles at the water's edge.

Fish that escaped the arrows of the archers were speared at the rapids or scooped up in baskets. Everywhere there were heaps and piles of fish. Heavy black buzzards circled lazily above. The wave of drugged water swept on past the island, diminishing in strength in the widening river. Immediately, from downstream, came numberless schools of fish, climbing the river to repopulate the area that had been polluted. They swept beneath our canoe in majestic formations.

Back in camp once more we sat down, exhausted, before a large box of exposed films. Every stage of the operation had been documented, and the weather had been perfect. The Campas, too, were satisfied. Fish were everywhere. Men and women alike cleaned them and smoked them on racks over the fire.

High Voltage Laboratory, General Electric Co.



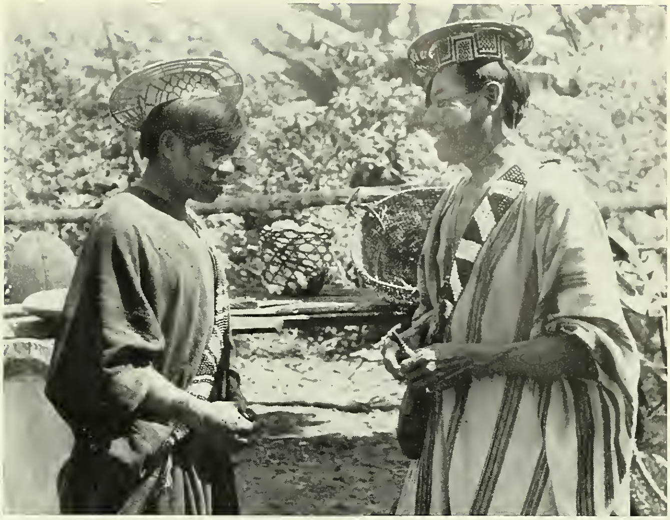
Petrified Lightning

If you see something that looks like a glass root sticking out of a sand bank, remove it gently

By Margaret Romer

WHEN you are walking among the sand dunes near the seashore or on the desert in a region where thunderstorms are frequent and violent, you may find a piece of "petrified lightning." It would probably be protruding an inch or so out of the sand at the top of one of the hillocks. You

◄ Some fulgurites, like this one, were made artificially. The appearance is the same



➤ CAMPA MEN relaxing after a day's fishing. The man on the right is chewing coca with lime from the small gourd in his hand, whereas the one on the left is holding a tubular wooden pipe

The odor of cooking fish filled the air. Here was food for many days. Wrapped carefully in leaves, the fish were loaded into canoes and onto balsa log rafts. The Indians began to break camp.

Without warning black clouds billowed over the treetops, and it began to rain. De los Ríos roared with laughter.

"Let it rain! Let it rain!" he shouted. "What do we care now?"

And we followed the Campas back to the Shehuaya.

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might take it for a piece of root and ignore it. But, better investigate.

If, on inspection, you find the object is not wood but a rocklike formation, you may have found a scientific treasure. When you try to remove it, be gentle, for it is very brittle. It is, in fact, natural glass.

Your discovery may go down into the sand any distance from a few inches to five or six feet, or even deeper. It may be only a fraction of an inch thick, or as much as three or four inches. It is apt to taper to a point, and it probably branches out underground, like a tree upside down. So, dig it out; don't try to pull it out—or you may end up with natural "cut glass."

Your prize will probably be grayish-white in color, and translucent; but it may be yellowish, greenish, reddish, or black.

A scientist would call the formation a fulgurite. The name comes from the Latin word for lightning. Lightning tends to strike high places, so you are more likely to find a fulgurite at the top of a dune than in the lower ground between. Sand is largely a nonconductor, offering a great deal of resistance. When the lightning strikes, the heat is so terrific that it melts the sand as the bolt plunges downward, but this lasts only a second, and it quickly cools. Result: a hollow glass tube. It is hollow because it actually cools and hardens before the sand has time to settle back into the hole created by the lightning.

The outside of your fulgurite will be rough and gnarly, with particles of sand welded to its surface. It may have bumps like petrified bubbles. If it was raining when the fulgurite was formed, moisture in the sand was suddenly turned to steam, which tried to escape. Then the sudden cooling of the molten sand froze the bubbles, causing the bumps. Sometimes these bubbles are broken through, giving a lacelike appearance. The protuberances are mostly near the surface and tend to disappear toward the deeper end of the fulgurite, because most of the water is apt to be near the surface of the ground.

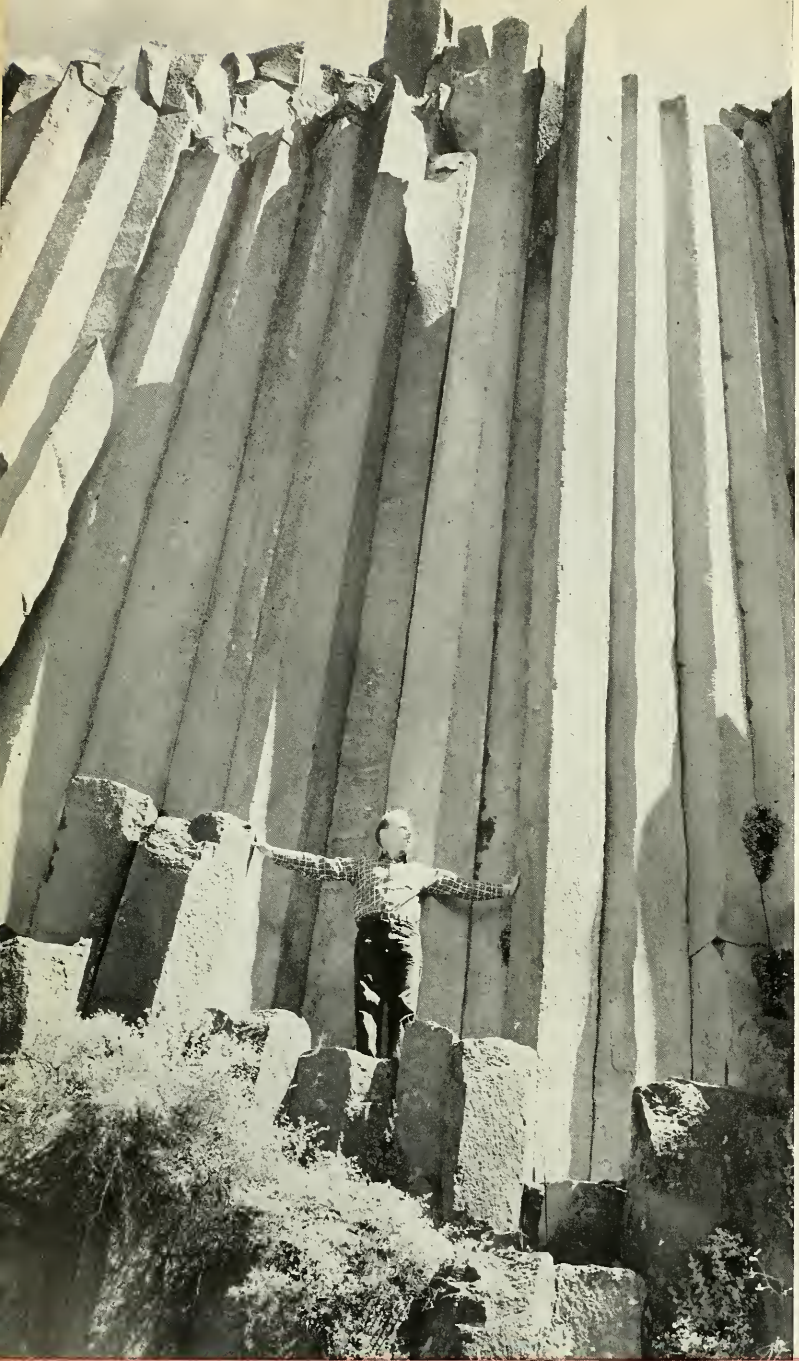
If you accidentally break your specimen in the process of digging it out, you will see that the inside is glassy and smooth.

Often, if these natural glass tubes are not found by someone, the wind may bury them in the sand and they will remain untouched for years. Then, by some chance of wind or storm, they will appear, sticking out of the bank of a sand wash. In the United States, the Carolinas have probably yielded the largest number, but many have also been reported in Nevada, Utah, and Michigan.

A pastor named David Hermann reported finding one of these formations in Germany in 1706, but nobody knew what it was. About 100 years later, 1805, a Dr. Hentzen figured out what they were and how they were made. But the first serious study of fulgurites was not undertaken until 1817. Today they are well understood and have even been made artificially in the laboratory by passing a powerful electric current through a pail of sand that has been grounded.

A synthetic fulgurite, of course, has no known value; but if you ever find a real one, you will have a scientific treasure.

the DEVILS POSTPILE



▲ LOCATED in what used to be part of Yosemite National Park, the Devils Postpile National Monument presents one of the world's most remarkable examples of its kind. The long leaning post just to the right of the center stands today as it did in 1909. It was unaffected by the violent earthquake of 1952

➤ A DIFFICULT ANGLE SHOT: a view looking down from the top of the posts. Note the man among the fallen fragments at the bottom

These spectacular columns speak of the remarkable behavior of a lake of lava and a great glacier

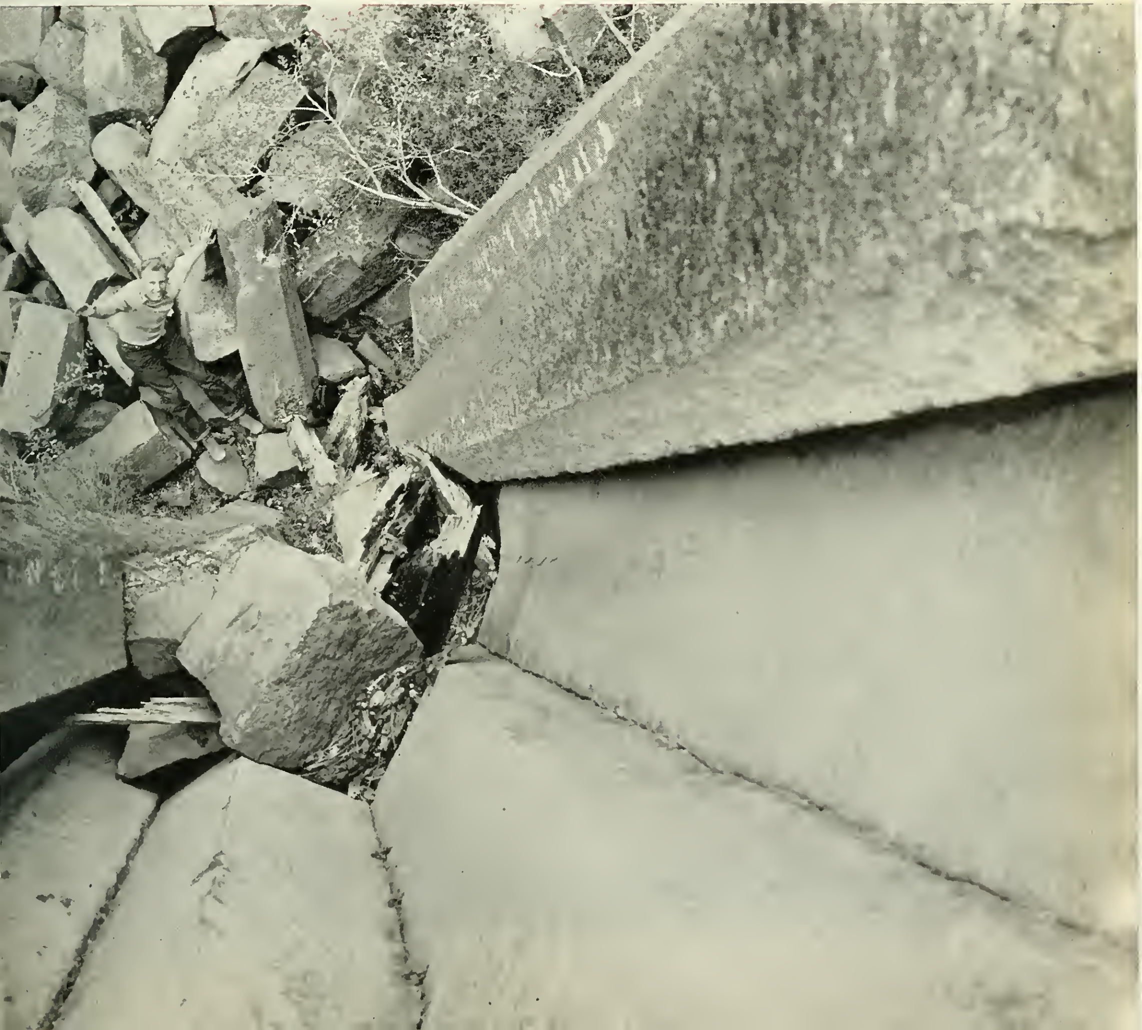
By Richard J. Hartesveldt

All photographs courtesy National Park Service

IN the years of the California Gold Rush, when the Forty-niners were swarming over the Sierra Nevada and its foothills, a discovery of another sort was made in the deep Middle Fork Valley of the San Joaquin River. Unaware of the riches that lay hidden in the near-by Mammoth Lakes Region, these wanderers were momentarily puzzled as they viewed an outcropping of basalt rock that was "cut" into straight regular lengths, as if by tools.

Some years later, the rock columns were again visited, this time by shepherds who found the open Jeffrey pine forests of the east slope to be desirable grazing for their animals. Apparently awed by the sight of the die-straight "posts" of rock, these God-fearing men are believed to have called them the Devils Woodpile. Later the site was renamed the Devils Postpile, probably because so many of the columns were upright.

Although it is one of the finest examples of basalt columns in the world, the Devils Postpile is not unique. Fingal's Cave in Scotland and the Giant's Causeway in Ireland are two other well-known examples of this kind of formation. Basalt columns are also found in Wyoming, Arizona, Germany, and



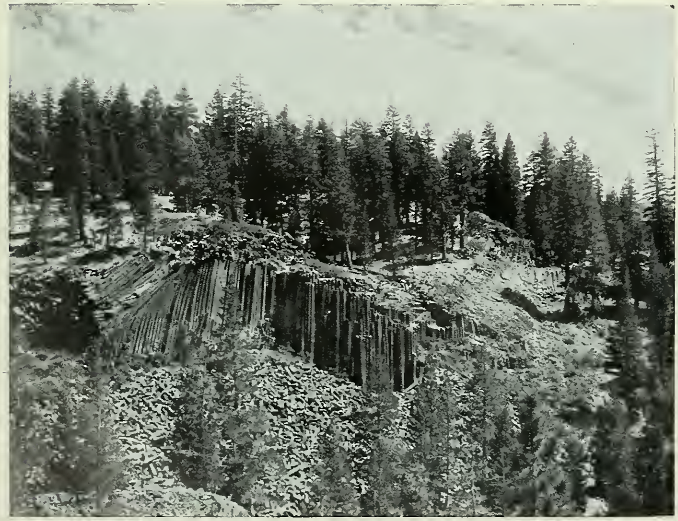
in several other parts of the world.

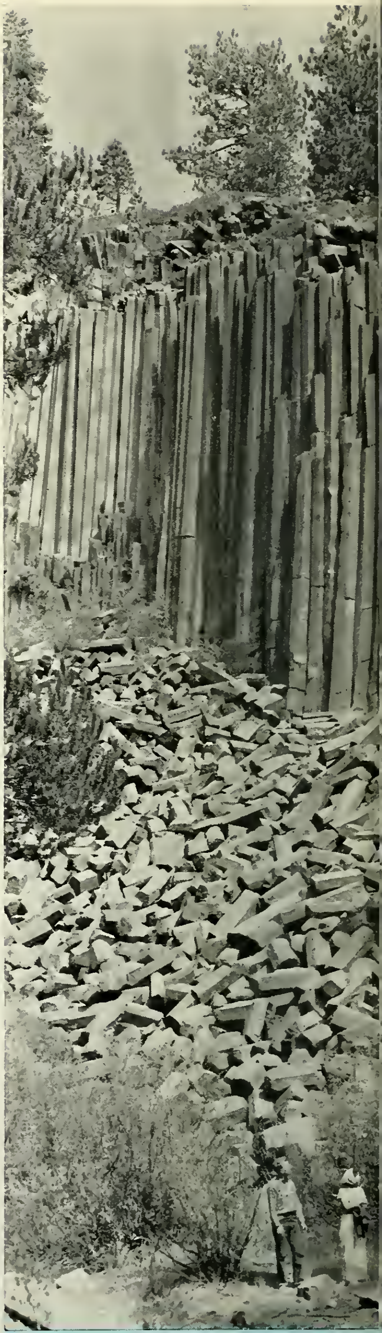
In 1890, the Devils Postpile was included within the boundaries of Yosemite National Park. Sixteen years later, pressure from water, mining, and grazing interests succeeded in having 500 square miles of land, including the Postpile, removed from National Park status. In 1910, the district Forest Service Engineer, Walter Huber, received an application for permission to blast the Postpile into the San Joaquin River for a dam to be used in mining operations. A glance at the accompanying photographs of this remarkable formation will probably convince the reader that its destruction for such a purpose would be a calamity. Mr. Huber's opposition to the plan led through a series of events to the establishment of Devils Postpile National Monument by President William Howard Taft on July 6, 1911.

With the creation of the Monument and the improvement in modes of travel, more and more people began to visit this interesting rock formation. "How was it formed?" was doubtless the question on the mind of every visitor then as later, when the present writer became the first ranger-naturalist stationed there. Several theories have been offered. One of the more common is that the huge pillars were simply basalt crystals of an uncommon size. But one of the writers for the Sunday supplements offered a more imaginative explanation: "Once it [the basalt] flowed in a molten torrent from a near-by crater, plunged over a precipice, split into prisms, and hardened in mid-air." Explanations like this may be a holdover from the cataclysmic geological beliefs of the preceding century, when the science of geology was in its infancy. In the light of more recent knowledge, a less spectacular but quite remarkable explanation is accepted as authoritative.

During the Ice Age, before the growth of the last glacier, a huge fissure opened in the earth's crust just south of Mammoth Mountain, and from it poured basaltic lava. The lava flowed down the steep slopes of the Middle Fork Valley, where it pooled as a lake 700 feet deep. As the lava cooled on the surface, it began to shrink. The

▼ THIS TELEPHOTO VIEW of the Postpile, taken from across the Middle Fork of the San Joaquin River, shows the main section of the formation. The bent and tilted posts at left were formed when the cooling of the lava lake did not proceed straight downward





▲ AFTER the basaltic columns were formed, the great glacier destroyed an unknown amount along this front

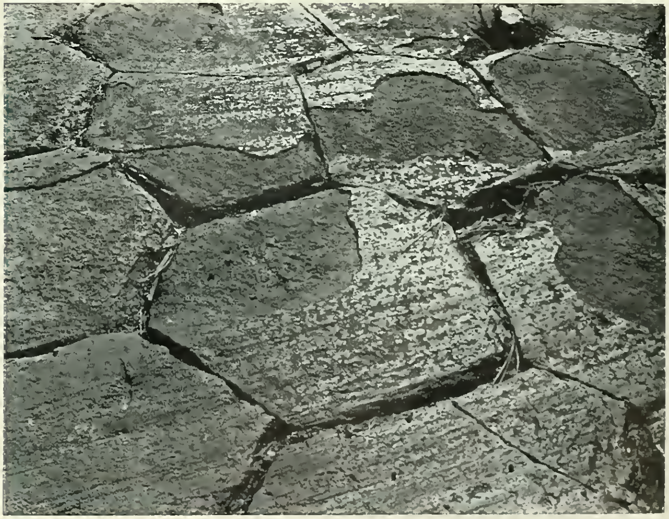
➤ **When the lava** of which the columns are formed cooled, it contracted and cracked much as mud does when drying

basalt of which the Postpile was formed was nearly uniform throughout, so that shrinkage was quite even across the surface. The tensions that were caused by the shrinkage were relieved by a cracking of the solid lava, somewhat as drying mud shrinks and cracks. The cracks radiated out from points spaced one to two and a half feet apart and formed the polygonal cross sections of the posts. Continued cooling and hardening of the lava caused the surface pattern of cracks to be extended downward, probably to the bottom of the lava lake. More than half of the resulting "posts" are six-sided, about a third are five-sided, and the remaining ones are four- or seven-sided. How long the posts originally were—or are now—is unknown. Some of the exposed sections extend 60 feet above the talus, and their bases are presumably many feet beneath.

The axis of a basalt column usually is at a right angle to the cooling surface. Thus, if the surface of the lava pool were everywhere level, theoretically, all of the resulting columns would be vertical. Many of the "posts" at the Postpile are not so aligned but are tipped and apparently bent. Possibly there were irregularities in the surface—layers of porous lava that insulated the material underneath—so that the cooling occurred obliquely. The effect of these insulators on cooling has been modified or lost at greater depths, causing the cracks to become nearly vertical again and producing the bent effect so prominent at the Postpile.

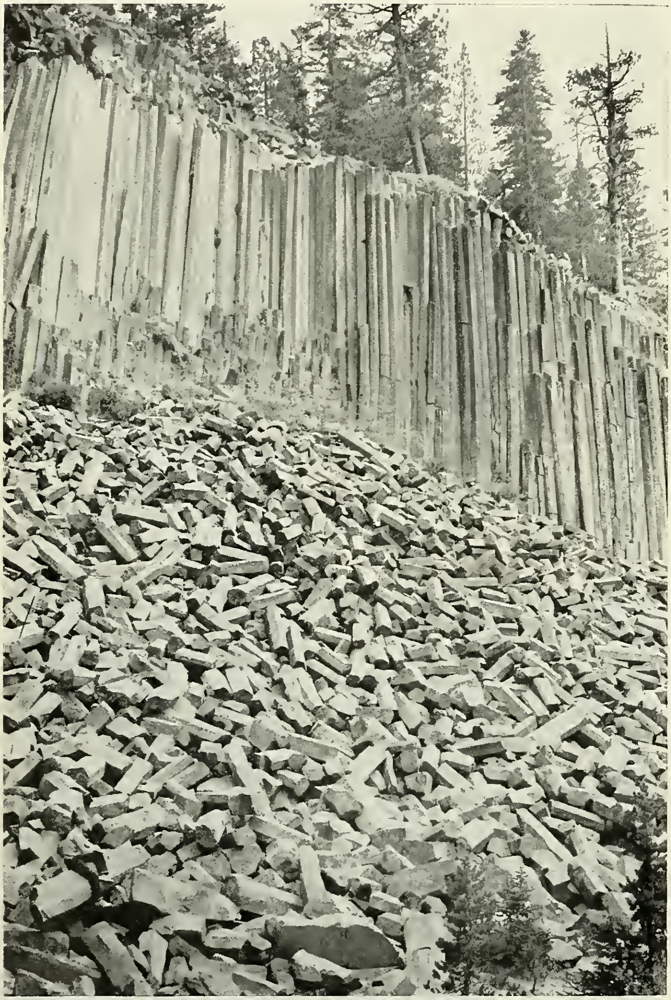
It remained for the last glacier that flowed through the Middle Fork Valley to expose the sides of the "posts." The cracked basalt columns presented but little resistance to the stream of ice 1000 feet deep that moved over them. The glacier quarried away nearly all of the lava in the valley and left only small remnants, the largest of which is the Postpile. Other basalt columns, less spectacular, are found at several places within or near the Monument.

Parallel grooves, or striations, were gouged out of the rock at many places by particles imbedded in the undersurface of the glacier. One groove, carved in solid granite near the southwest corner of the Monument, is three inches deep, ten inches wide, and more than ten feet long. Elsewhere, the ice polished the surface of the rock. Although some of the gloss has now gone under the influence of the



weather, much of the surface is still smooth enough to reflect the rays of the sun.

Since the retreat of the glacier, the Postpile has disintegrated considerably, as shown by the accumulation of broken posts. At one time, its face must have stood many feet in front of its present location. Water, finding its way into the cracks between the columns and then freezing has undoubtedly been responsible for prying the posts apart and causing them to fall. The rate of falling is unknown but is certainly quite slow. Very few sections of rock have fallen recently. Three columns that are leaning away from the face of the cliff are separated from the others by as much as twelve inches at the top. Although they appear ready to fall with the slightest earth movement, photographs taken in 1909 show them in the same position as they are today. The violent earthquakes of 1952 (Tehachapi), which were felt strongly in the area, left no evidence of falling.



▲ THE DEPTH to which the columns extend is unknown, as is also their original height

Near the Postpile, there are also hot and soda springs. These are further manifestations of past volcanic activity. Water heated by hot rock at great depths rises to the surface at near-by Reds Meadow. The U. S. Forest Service has piped the hot water into a public bathhouse, where it is enjoyed by the many campers in the valley. In Soda Springs Meadow, also not far from the Postpile, is found one of the better-known soda springs of the Sierra Nevada. It lies on a gravel bar in the river bed and is covered with water until some time in July. The water has a delightful flavor and is much sought after by local campers as a mix for fruit juices.

The phenomenon of natural carbonation is the result of subterranean gases being forced into the water under pressure. Different gases are given off by molten rock during its various stages of cooling, carbon dioxide being the last to be discharged. Flowing spring water absorbs the gas and is carbonated by it. Upon reaching the surface, much of the gas escapes from the water. Other minerals dissolved in the water flavor it. The near-by gravel is stained a reddish color by iron precipitating out of solution.

Devils Postpile National Monument is located about 30 miles southeast of Yosemite Valley. Access to it by automobile is possible only from the eastern side of the Sierra Nevada. Follow U. S. 395, the Mammoth Lakes Road, and a dirt road that drops 2,000 feet into the Middle Fork Valley. Several campgrounds are provided by the U. S. Forest Service and one by the National Park Service. A store and cabins are operated during the summer months at Reds Meadow. Inquiries about Devils Postpile should be directed to the Superintendent, Yosemite National Park, California.

▲ THE ANCIENT VILLAGE is on top of the mesa at the left

Crack-in-the-Rock

A prehistoric ghost town with a daring approach

By WILLIAM B. SANBORN

Photographs by the author

SHORTLY after sunrise, we left the Wupatki headquarters; and an hour's drive over truck trail, past many ruined pueblos and through open plateau country, brought us within view of the Little Colorado River. Behind us lay the Grand Canyon, east the Hopi country, and dominating the skyline to the southwest were the majestic San Francisco peaks. Here the river makes a broad bend through a region where the desert floor is broken by a number of small knifelike mesas. Prehistoric ruins are atop each, and of particular interest is the ruin called Crack-in-the-Rock.

Although not large, Crack-in-the-Rock is one of the most intriguing prehistoric sites in Arizona yet one of the least publicized ruins of the Wupatki National Monument. Travel to the ruin is not easy, since many miles separate it from graded road. Also, permission to visit the site must be obtained from the Monument Superintendent.

Crack-in-the-Rock has been known for years to the local cowboys, Hopis, and Navajos; and we were able to get within a mile of the ruin in the truck. This remote section of Wupatki Monument consists of colorful badlands, which slope gently toward the arroyo of the Little Colorado. Our mesa stood silhouetted against the early morning sky, its rocky slopes and surrounding desert floor a rich red-brown hue. We had to study it closely to distinguish between the actual rock itself and the ruin, since the village had been built of the same red stone.

The mesa dips eastward and is some 250 feet long, rising about 100 feet above the desert floor. Perched atop this narrow fin of sandstone is Crack-in-the-Rock, a small pueblo village dependent on farming like the majority of prehistoric settlements in Wupatki. The mesa is banded with a remarkable series of petroglyphs chipped into the rock surface. Of particular interest are the many tiny human and animal "glyphs" that appear. In two places there are lines of several figures and animals, as if on parade, with some figures depicted carrying burdens.

Why the name Crack-in-the-Rock? The top of the mesa is edged by a sheer 15- to 20-foot wall of sandstone, which the visitor must scale to reach the main dwelling. On the south side is a large crack, which penetrates into the mesa and then turns upward to emerge as an opening in the center of a large room in the village. The ruin gets its name from this unusual avenue of approach. The prehistoric people had climbed up and down through

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* WILLIAM B. SANBORN *has visited almost all of the 79 National Parks and Monuments in Western United States. He is Supervisor of the Department of Audio-Visual Education in the San Francisco Unified School District.*—ED.

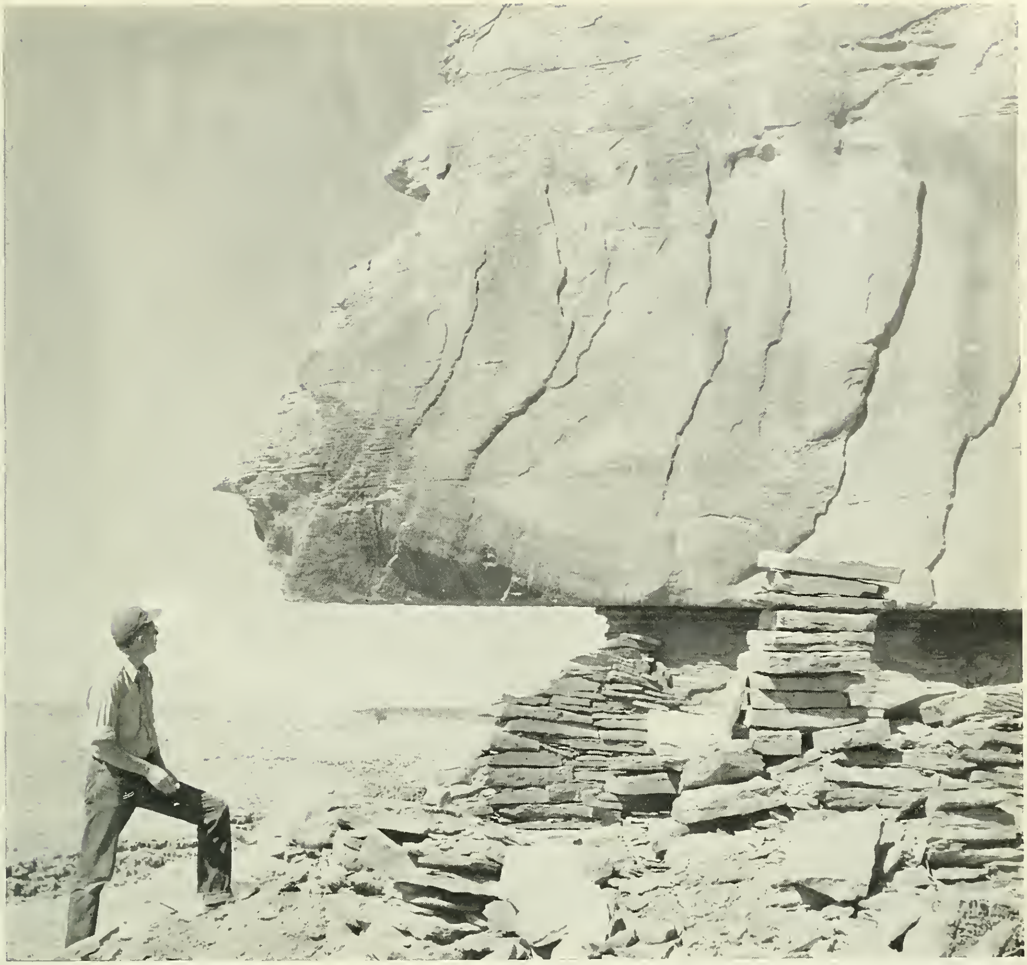
▲THE AUTHOR'S WIFE explores a portion of the standing walls of the ancient pueblo

▼ THE AUTHOR emerging from the "crack" into what was a room of the village before it fell into ruin

this cleft so long that the stone was polished almost smooth. In some places a stone hammer had been used to enlarge the passage. With the correct "twist," we found we could climb up through the crack in less than ten seconds, emerging amid the rubble of the fallen room atop the mesa.

From the village you had the feeling that you were atop a miniature Acoma or some Hopi mesa. On all sides spread a fascinating panorama of desert scenery, punctuated with the mesa-top locations of other similar small villages. Crack-in-the-Rock is fairly well preserved. At least four buildings still stand, and the entire village outline is easily seen. The village may have had around 25 rooms at the peak of occupancy. Potsherds and spallings litter the mesa-top, as they do the talus slopes.

Crack-in-the-Rock was inhabited during the eleventh and twelfth centuries, as were many other dwellings of the Wupatki area. The people lived primarily by cultivating the surrounding flats, which at that time were covered with a deposit of volcanic ash. This ash came from an eruption of near-by Sunset Crater, around the year A.D. 1066. Prior to this, poor soil and



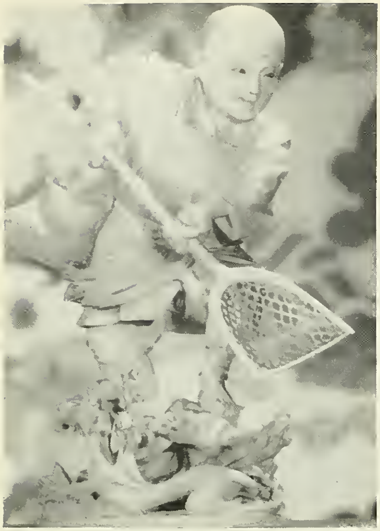
⮝ **Around the base** of the cap rock of the mesa are a number of small one-room units as shown here. Note the dozens of pictures pecked in the rock, which can be seen in great abundance and variety at this location

limited rainfall kept the region from being thickly settled. The eruption covered hundreds of square miles with a layer of cinder ash, which held sufficient moisture from rain and snow to grow crops.

The area proved to be a sort of "melting pot." Indians from all directions and from different cultural areas moved in to live and farm the new lands. It is believed that, as the years passed, this valuable life-giving ash was stripped from the surface by the frequent strong winds and piled high in useless black dunes. This, coupled with a period of drought that began in A.D. 1276, is thought to have finally forced the complete abandonment of these villages by the early 1300's. The prehistoric farmers moved out, seeking areas supplied with adequate water and soil. Many of them probably moved onto the mesas we now call the "Hopi country."

Crack - in - the - Rock stands deserted, blistered by intense summer heat and swept by severe winter blizzards. Its only inhabitants are rodents, the beautiful collared lizard, and perhaps an occasional bobcat, coyote, or desert fox. Birds make their nests in the ruined walls and in niches along the edge of the mesa, while high above soar the ever-present hawks, lazily playing the air currents over the mesa.

With the approach of midday and its heat, we descended through the crack and started back to the headquarters area. Among hundreds of ruins visited, the unique little pueblo of Crack-in-the-Rock on the Little Colorado remains one of our favorites.



▲ AN AGED FISHERMAN, wearing a protective straw garment, is busy by the water's edge
"My basket and net are yours, little fish.
But if you take them, you are mine, little fish"

THESE carved ivory objects, known as *Okimono,* have their artistic roots deep in the cultural tradition of Japan, though most of them were produced during the nineteenth century. Japanese art was fostered originally by religious institutions. Carvings in ivory were used by the temples primarily as ceremonial objects. In time, a feudal society evolved, and wealthy landholders began patronizing the arts. Some craftsmen in ivory migrated to areas where their art might be encouraged, and it flourished in the period of the sixteenth, seventeenth, and eighteenth centuries.

These *Okimono* are purely ornamental and are not intended for use or wear, in contrast to the smaller *Netsuke* pieces, which formerly served as a button for the tobacco pouch. The carving of *Netsuke* began to flower at about the end of the seventeenth century, reaching a climax in the eighteenth. The carving of *Okimono* apparently stemmed from this trend toward work on a miniature scale.

In general, the subject matter dealt with deities and mythological characters, plants and animals, and with the homely everyday life of the people, realistically yet artistically reproduced with careful attention to detail. The figures are only three to six inches high.

One must be aware in looking at the Okimono that more is present than meets the eye, because the ivory carver's faithful reproduction of his subject is imbued with an overtone, which suggests the peculiar charm, the characteristic atmosphere of Japan. Each *Okimono* is not only a picture but an intensification of a Japanese quality.

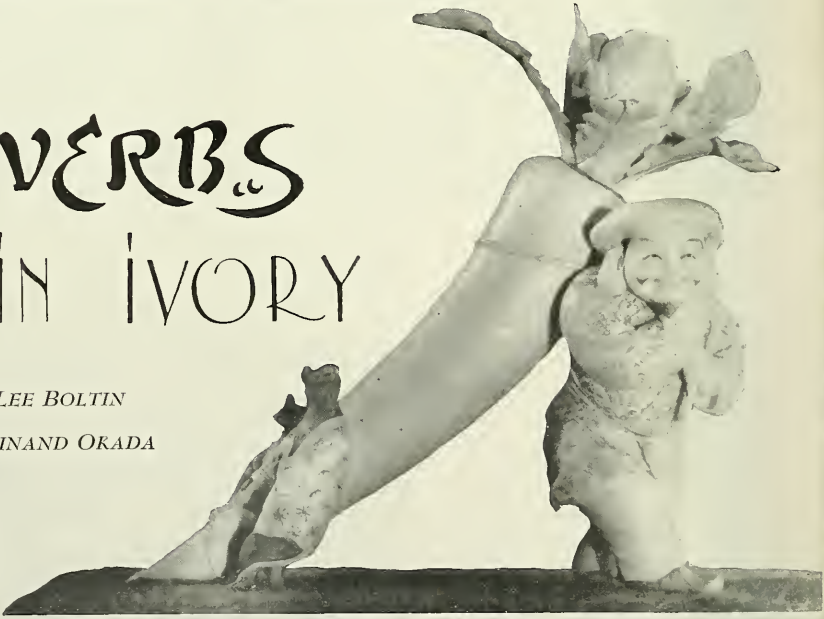
The *Okimono* shown here form but a small part of the collection of the late Dr. I. Wyman Drummond, whose Chinese and Japanese carvings in jade, ivory, amber, and wood have resided in the American Museum of Natural History since 1934.

Tiny Okimono *ivory carvings, through subtle symbolism, convey the esthetic and spiritual philosophy of nineteenth-century Japan*

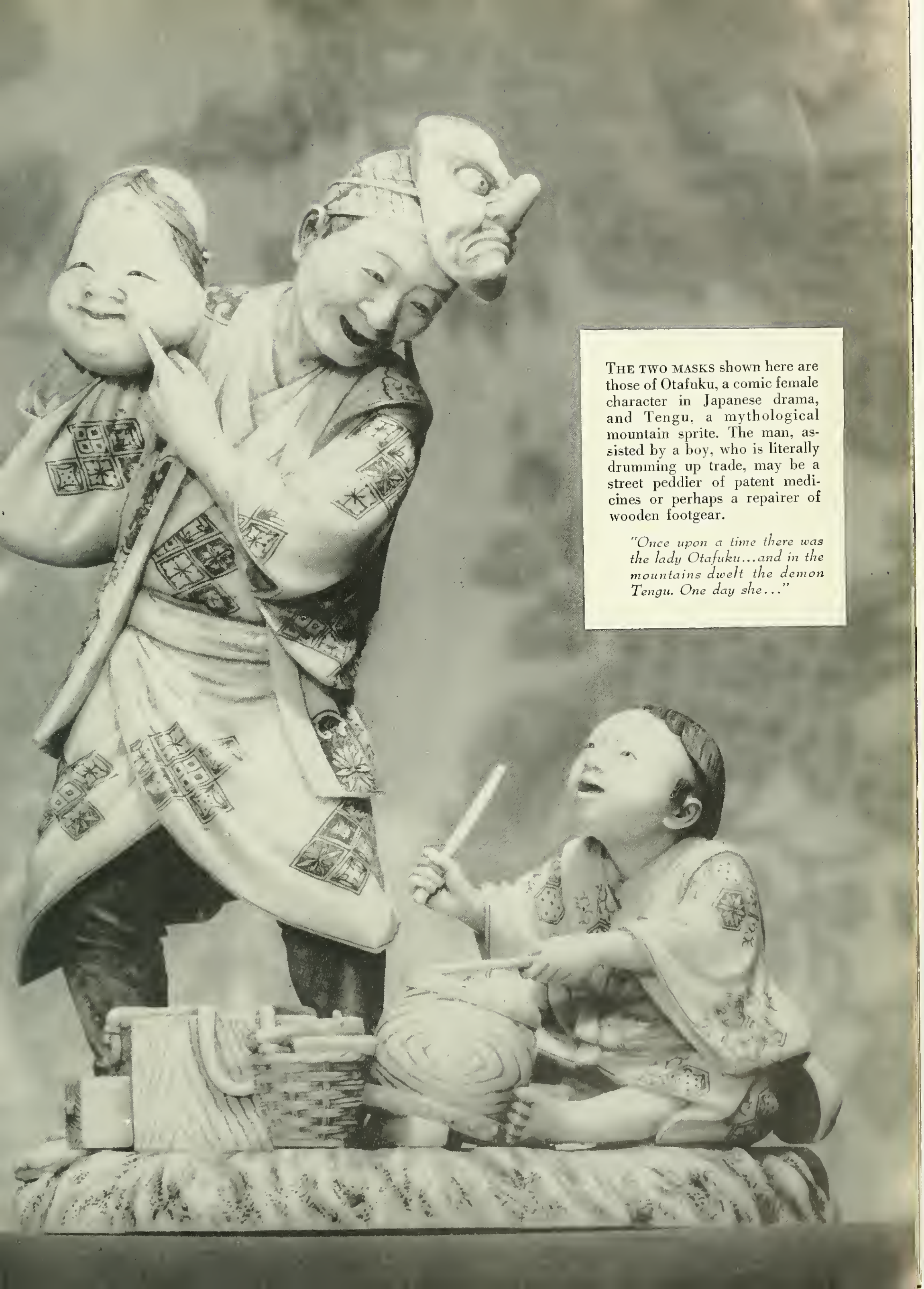
PROVERBS IN IVORY

A Photo Series by LEE BOLTIN

Described by FERDINAND OKADA

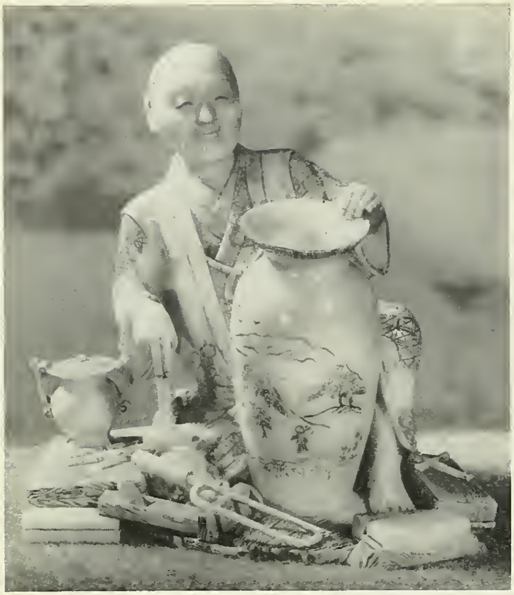


▲ DAIKOKU, God of Wealth, one of the seven gods of happiness, hauls a giant radish assisted by friends
"Happiness and Prosperity are as two hands clasped"



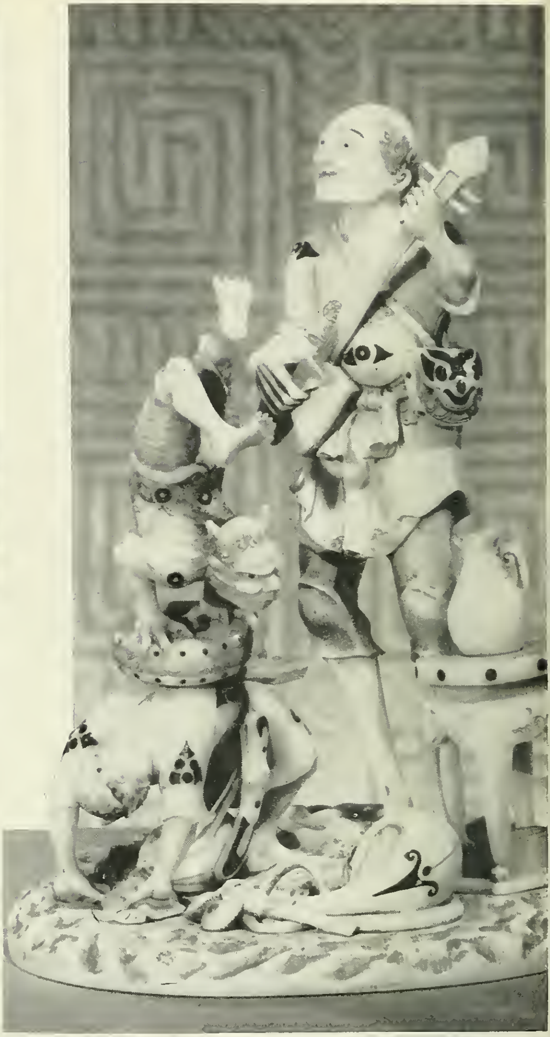
THE TWO MASKS shown here are those of Otafuku, a comic female character in Japanese drama, and Tengu, a mythological mountain sprite. The man, assisted by a boy, who is literally drumming up trade, may be a street peddler of patent medicines or perhaps a repairer of wooden footgear.

> *"Once upon a time there was the lady Otafuku...and in the mountains dwelt the demon Tengu. One day she..."*



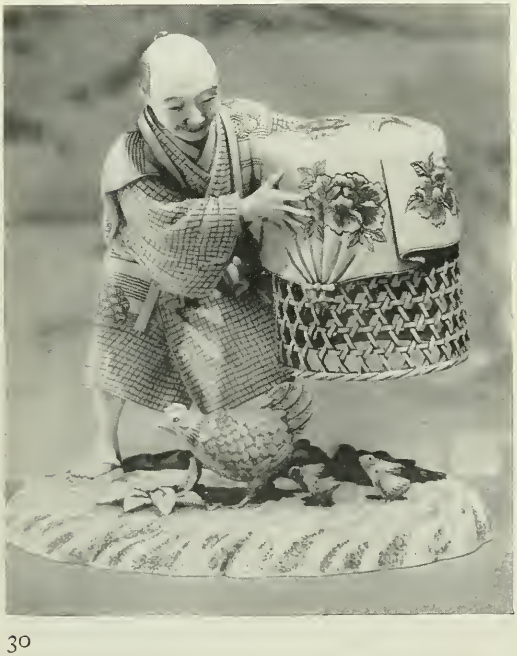
▲ A CRAFTSMAN. surrounded by his tools. looks with approval upon a vase he has completed

"It is given to the gods the gift of creativity. But some men have been touched by the gods and know a joy more golden than sunrise"



▲ IN CONTRAST to the realistic treatment of most of these figures, a touch of fantasy appears in the treatment of this minstrel. He is playing on his instrument. the *samisen*. and is accompanied by acrobatic, horned demons known as *oni*

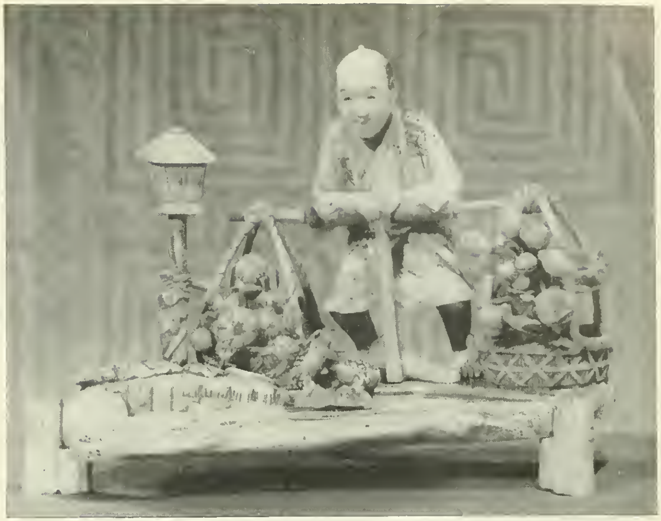
"It is not my song or my instrument, it is the voice of my heart that makes oni *demons dance and the people listen"*

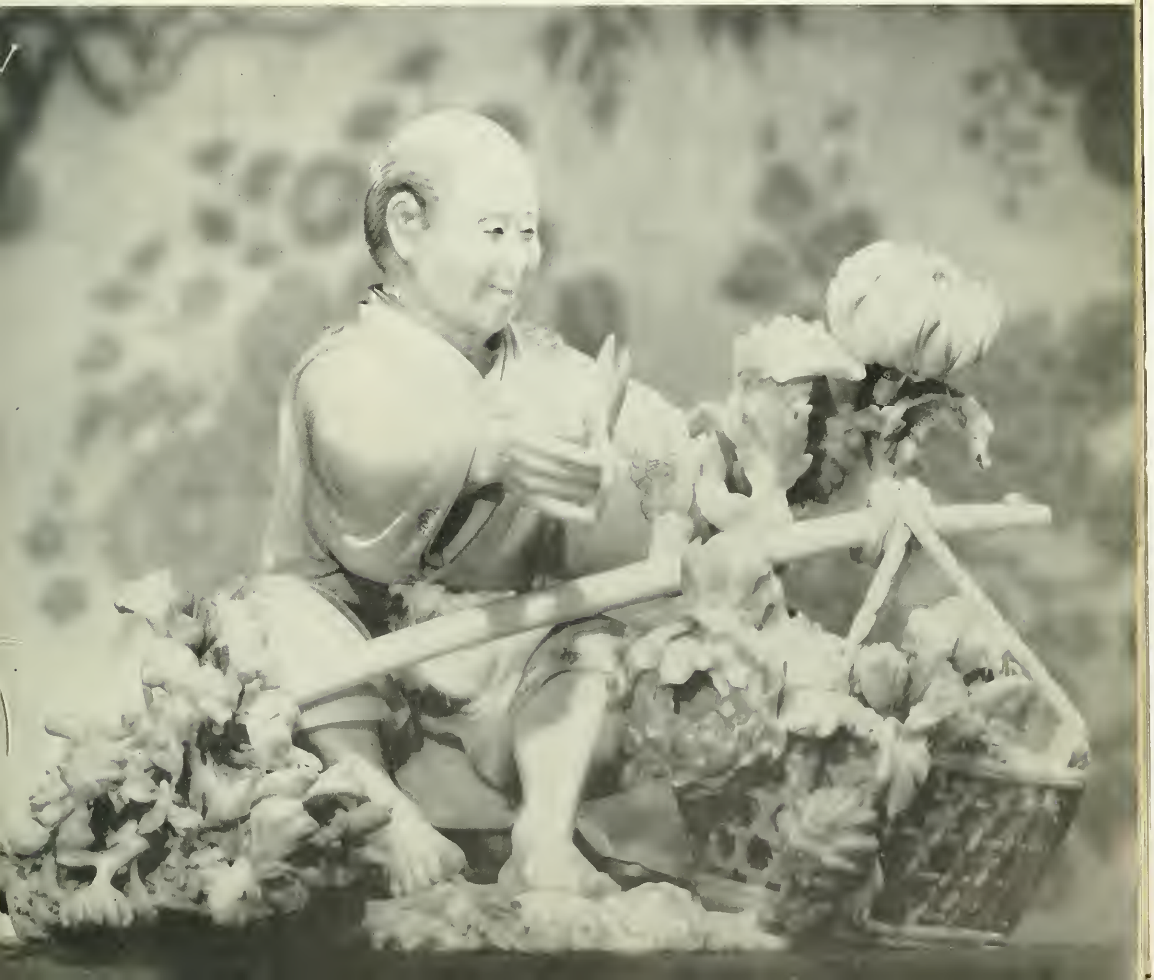


◄ A HEN AND HER BROOD. probably held in value by the owner, are released from a cloth-covered basket. which sheltered them over night

"Oh Lord Buddha, thy smile has caused the world to prosper and multiply! Great indeed is thy blessing"

TWO ITINERANT flower-sellers are shown here. One has paused to watch the antics of two frogs on a rock in a stream. The other is trimming his chrysanthemum blossoms. Frolicking animals are a favorite subject in Japanese art. Japan has known the earthquake, the volcano, and the typhoon; and so much of her islands are mountains that fertile soil is confined to a small portion of her land. Yet nature has smiled in the midst of her anger and left a paradise in miniature—not only flowers for all and small animals to laugh at but a people to appreciate them



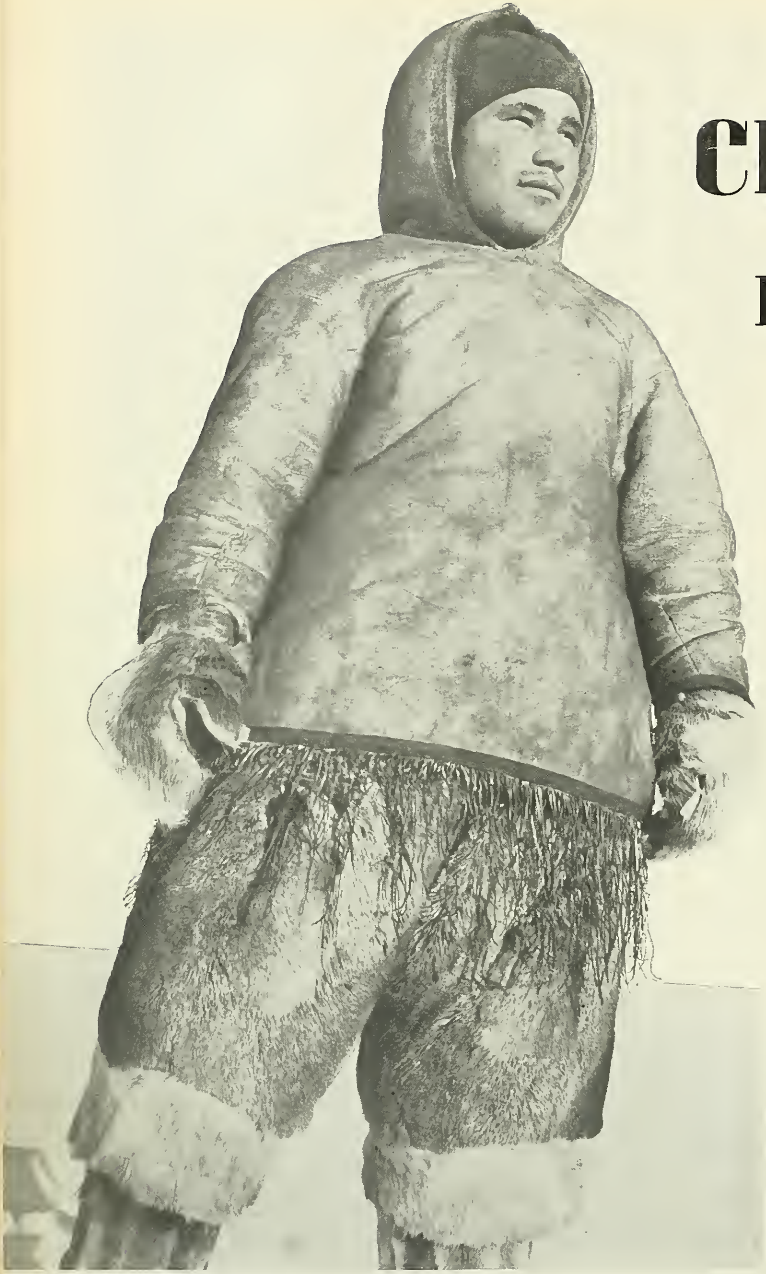


Clothes make th

By

VILHJALMUR STEFANSSON*
Baker Library, Dartmouth College

With photographs by
RICHARD HARRINGTON
from Three Lions



▲ ONE JACKET of caribou skin keeps the Eskimo warm in cold weather if he is even moderately active. The hair side is worn next to his body so as to maintain an air space. Within the garment the warmed air, being lighter than the outside air, tends to rise but is prevented from escaping, except very slowly, through the snug but not tight fit of the shirt over shoulders, breast, and back. The knitted cap, a white man's innovation, interferes with the air-capture principle enough so that hoar frost may form which, on melting, wets the garment

DURING the winter of 1909, an elderly woman of Flaxman Island, northern Alaska, went out to gather driftwood half a mile from her house. She was wearing only one coat or shirt, hair side turned in. With a sudden onslaught rare in the Flaxman country, a gale descended. She could not find her way home; she had to wait the storm out.

Most Eskimos would have built themselves some sort of a shelter in such a blizzard, but our aged woman thought it too much bother. In the blinding storm, she felt around with her feet until she discovered a tiny knoll. Taking off her mittens, she placed them on the hillock and sat down, using them as insulation to keep her body heat from melting the snow beneath her. Like all good Eskimo garments,

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* The author of this article needs no introduction to anyone with even a passing interest in the parts of the world that before his time were seldom thought of as "the friendly arctic." Vilhjalmur Stefansson is probably the first person to have explained in detail that the Eskimos in the construction of their houses with an entrance corridor below the level of the

ESKIMO

The air-capture system of
heat control was the ingenious
discovery by which the Eskimo,
in 50 degrees below zero,
learned to work outdoors in
comfort with only one loose
garment covering his naked body

her jacket was so designed that she could slip her bare arms out of the sleeves to cross them within the coat upon her bare breast, thus warming them and using them as added radiators to warm the inside of her shirt. With her back to the wind, she settled herself to wait the gale out, leaning slightly forward with elbows on knees so as not to topple over when she fell asleep. She slept as much as she could. Every now and then, stiffened from sitting, she would pick up her mittens and walk around in a small circle. When tired of this, she would sit down again on them and try to sleep. The gale lasted till late afternoon the next day.

When the weather cleared, the old lady came home. She was not very hungry, because she had slept

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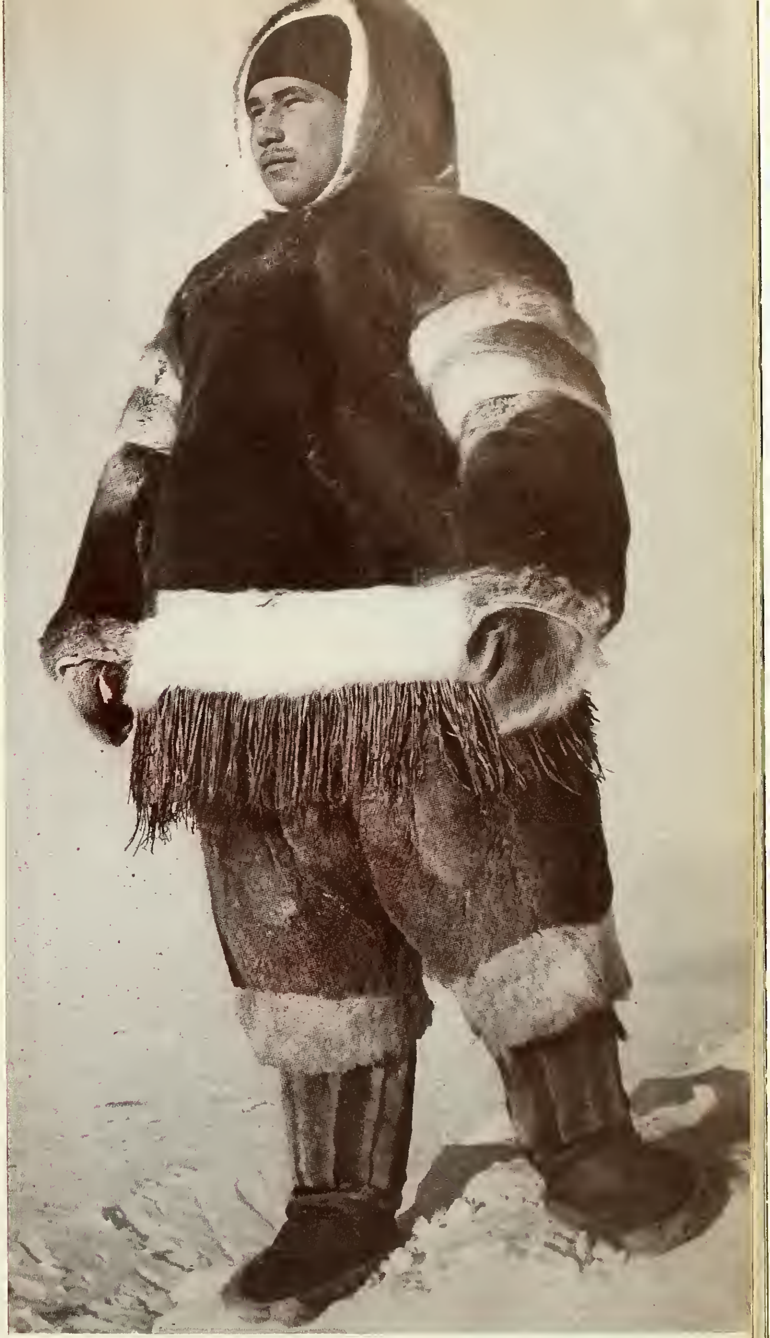
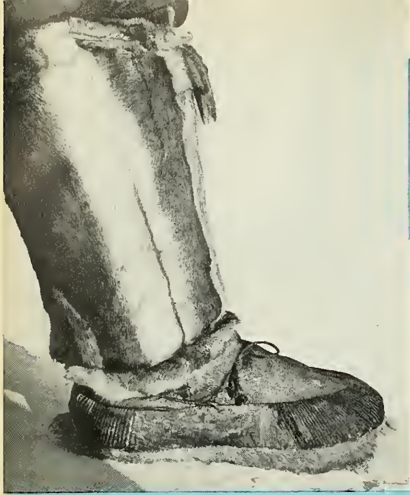
dwelling space, discovered and utilized the principle of the air-capture system of heat control. The same principle is used also in the design of their clothing, as explained in this article, which results from many years of study on Dr. Stefansson's part, including special work for our armed forces.—Ed.

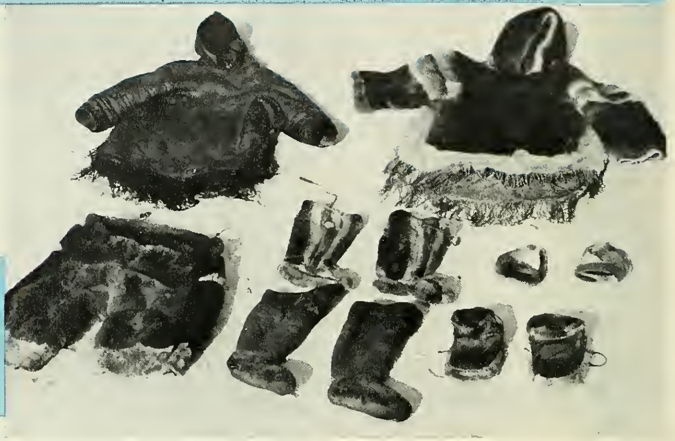


▲ If inactive in the coldest weather, the Eskimo may wear an additional jacket of caribou skin. In this two-garment set, or in a single garment if well constructed with moderately long fur inside to create a good air space, Eskimos, and whites used to Eskimo ways, sit out blizzards. The sleeves are wide enough between elbow and shoulder to pull one's arms inside and sit with them folded. You sleep slightly hunched forward

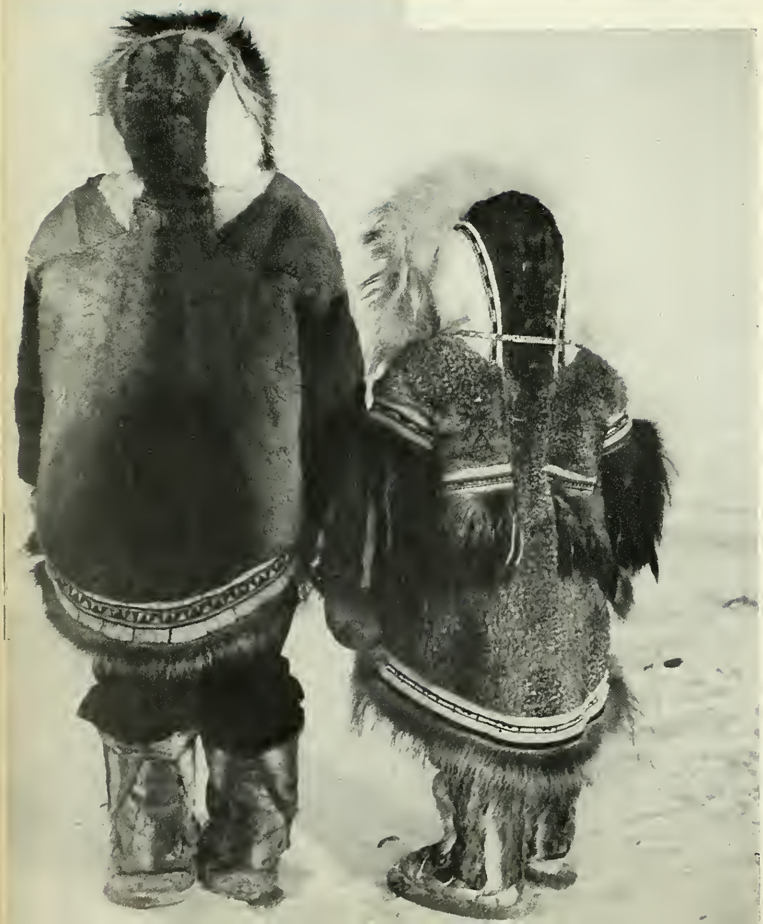


◂ **THE FUR BOOT** goes high enough for the downward-open trousers to overlap it by several inches. Air-capture principle applies within boot except under foot. There body weight expels air, and slippers, insoles, or both give insulation

▾ **HERE** is the complete cold-weather outfit, entirely of fur. It includes an inner and an outer hooded jacket, pants, boots and socks, shoes, and mittens



▾ **A COPPER ESKIMO** brother and sister in warm fur clothing. The little girl's hooded jacket has wolverine trimmings, a decoration idea borrowed from Alaskan women's fashions



or rested most of the time. It was during the first day that she had been most hungry. No one thought anything of her experience, except that some argued that she should have taken the trouble to build a shelter.

Had she known she was going to be caught out, she would have worn two coats, the entire costume weighing about ten pounds. What she wore, weighed six or seven. A Minneapolis businessman going to his office in January would wear from 20 to 30 pounds, and he wouldn't be planning to sit out a two-day blizzard. The difference in their clothing systems explains largely why the average Minnesotan is more eager to move to California than the average Eskimo. In our time, the Eskimo has been the sole possessor of a clothing system adequate in the sense that it permits in January a degree of mobility, efficiency, and comfort similar to that of July. We have taken a long time to understand how it works, and we are still a long way from making full use of its principles.

Drawing upon archaeology, ethnology, and history for a sketch of costume through the ages, we find that man has developed two basically different types of cold-weather clothing: snug garments and loose ones. The snug garment protects the body through *direct insulation.* The loose garment employs the *air-capture* principle.

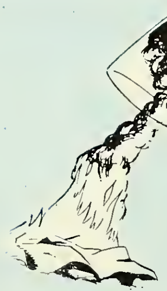
The snug garment reached its greatest extreme in the European form-fitting woolen or silken garb of certain medieval and early modern periods. It is also seen in the buckskins of some North American Indians. The principle is the same as the one you use when you wrap a hot-water bottle in cloth to keep it warm.

The extreme of the loose type is the cape or poncho hanging from the shoulders around an otherwise naked body. The Tierra del Fuegians, at the southern tip of South America, depended on a single garment of this type. The air-capture garment must be of nonporous material, because the warm air under it must not escape and be replaced by cold. If you burn a rag in the mouth of an inverted glass tumbler, the smoky air, warmed by the flame, will rise into the tumbler and stay there. It will leave only when it is chilled by conduction through the walls of the glass or when it gets mixed with colder air from below through the process known as the diffusion of gases.

Though it is doubtful that the primitive inventor understood it as a principle, he used the air-capture system when he evolved the nearly airtight cape resting on the shoulders and coming down almost to the ground. The air within this inverted container was warmed by body heat and thereby given an increased buoyancy, a tendency to escape upward or sideways. But upward and sideways there was no escape, because there was no opening. Loose clothes, as protectors from cold, rely mainly upon a single garment of such quality and design that the wearer finds himself in an air pocket where his skin is separated at most points from the garment.

Of course there are many intergraded combinations of loose and snug garments. Among these are the Roman toga and the modern overcoat, each coming well down outside one or more thicknesses of tight garments. But our overcoats lose much warm air at the neck and through the opening where they button.

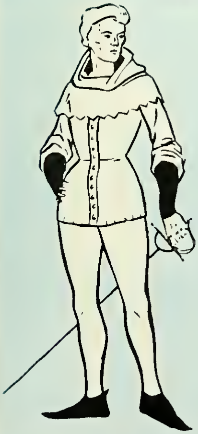
To understand the importance of the air-capture principle as a primitive invention, it must be realized that life in the far north would probably have been impossible without the application of this principle in the design of dwellings as well as clothing. The Eskimos build several kinds of winter houses in different parts of their territory, and the materials may be snow, stone, sod, driftwood, or combinations of these. Earlier travelers sometimes said that the Eskimos pointed their dwellings toward the sea, or toward a pretty view; others thought they pointed them toward the sun, or away from the wind. But we now know that they simply point them in the direction that will permit them to build an upward-sloping entrance passage. This passage opens into the living quarters through a trap door in the floor or at least through an opening that is below the general level of the sleeping and working area. This prevents the warm air



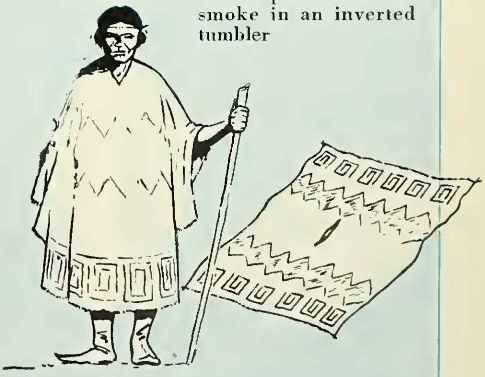
▲ THE AIR-CAPTURE PRINCIPLE is demonstrated by the imprisonment of smoke in an inverted tumbler

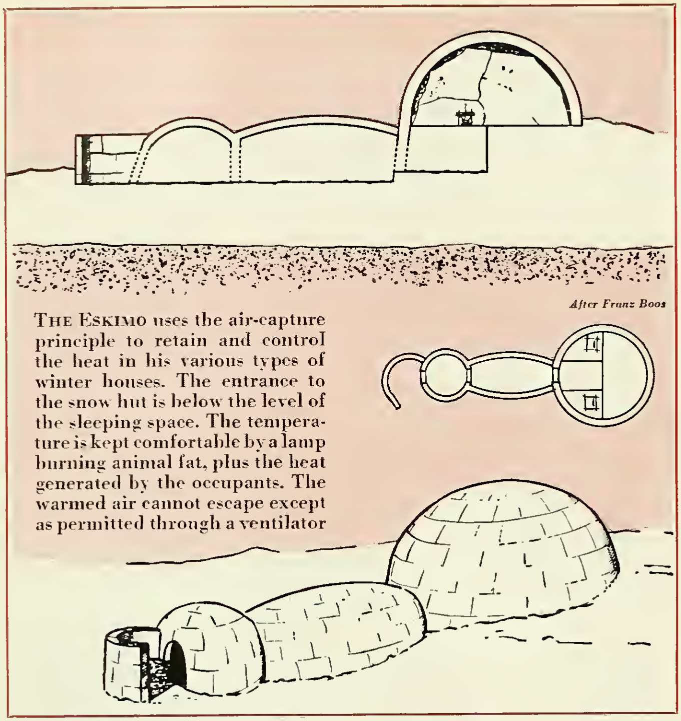
Drawings by Robert Gartland

DIRECT INSULATION VS. AIR-CAPTURE PRINCIPLE



CLOTHING around the world is of two basic types. Our own style employs the principle of direct insulation and comes down to us from the early European form-fitting woolen or silken clothing, as shown at left. The other principle is that of air-capture and is illustrated by the poncho worn by certain South American natives, as shown at right. Eskimo garments, the most efficient known, use this principle and may have evolved from something like this. Garments designed on the air-capture principle must be nonporous, because they depend upon holding the warmed air, which tends to escape either upward through an opening or outward through pores in the material. The latter process permits hoar frost to form, which may melt and freeze as ice




After Franz Boas

THE ESKIMO uses the air-capture principle to retain and control the heat in his various types of winter houses. The entrance to the snow hut is below the level of the sleeping space. The temperature is kept comfortable by a lamp burning animal fat, plus the heat generated by the occupants. The warmed air cannot escape except as permitted through a ventilator

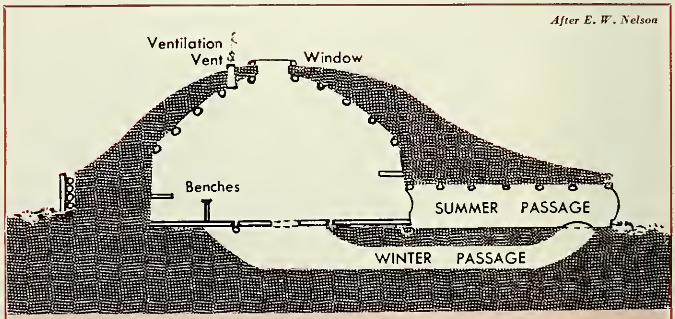
from escaping. Le R. P. E. Petitot pointed out that the Eskimos made use of the air-capture principle in their houses, but the fact has been generally overlooked.*

When the quarters are small for the number of persons occupying them, and if the roof is thick enough, the Eskimos are able to live with little or no fire in houses built in this fashion on the air-capture principle. Where fuel is abundant, larger houses can be used and the roof does not need to be so thick. The air-capture principle is so dependable that the alleyway does not need to be closed against the weather. Babies roll around naked in the average Eskimo hut in most of the cold districts, just as the Eskimo in his clothing outdoors is naked beneath the loosely fitting garment that is freely open only at the bottom. Both dwellings and clothes are air containers that open downward, in which the warmed air is held captive by its tendency to rise.

The air-capture principle seems to be used by the ground squirrel of the Midwestern prairies. It digs its burrow slantingly downward, then horizontally, and the last a few inches upward to its wintering chamber, where the heat developed by its life processes is conserved by the inability of warmed air to flow downward into cold. Possibly the Eskimos saw the muskrat and seal using the same principle and applied it in evolving their own dwellings.

One house I knew in the Mackenzie Delta was kept at a temperature of around 60 degrees Fahrenheit through the winter of 1906-07 simply by the body warmth of the two dozen persons who lived in it. When cooking was going on, the temperature rose to 90 degrees and higher. It was then necessary to open a ventilator in the roof to a width of six or eight inches. While body heat alone was being used, it had been kept open only, say, two inches. With an outdoor temperature of perhaps 40 below and an indoor one of perhaps 90 above, there was such a gravitational difference that the warmed air rushed out through the chimney with the force of a blast. Then the cold air from out of doors would well up slowly through the much larger trap door and spread out over the floor, in such a way that anyone who wanted to could lie down and cool off.

People accustomed to gravity control of air in their houses would naturally apply the principle also to their clothes. The Eskimos may never have reasoned this out, but somehow they got into the way of using the principle, and they applied it rigorously in the designing of hooded garments that hung about midway from hip to knee.



After E. W. Nelson

▲ THIS SCHEMATIC DRAWING shows how the air-capture principle is used in an Alaskan earth-and-wood house. In summer, the gut window is removed and a ground-level entrance is used. In winter, these are both closed, and the house is entered through a passage by which the buoyant warm air cannot escape

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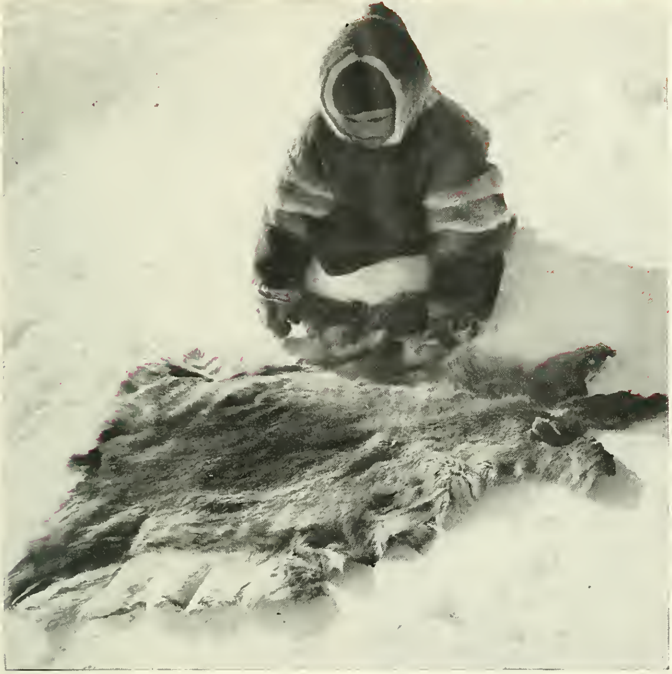
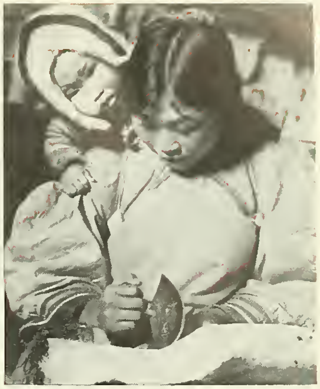
Vocabulaire Francais-Esquimau, 1876, page xxi of Introduction.

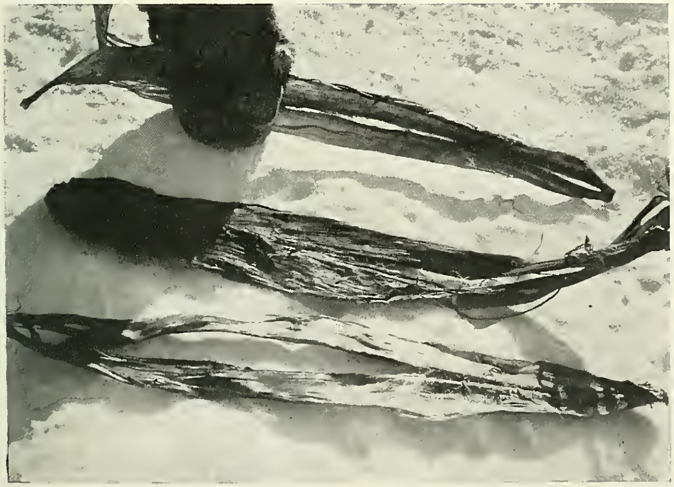


▲ THE RAW MATERIAL of which most of the Eskimo's wardrobe is made: caribou skin

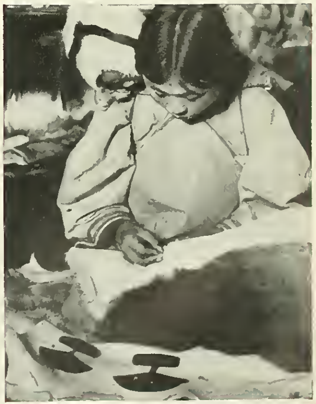


▲ USING HER SEMICIRCULAR KNIFE, the *ulu*, the Eskimo woman cuts through the caribou skin. This mother, being "modern," has covered her own fur jacket with cloth. Following the traditional design, the jacket contains added space in the back for carrying the child

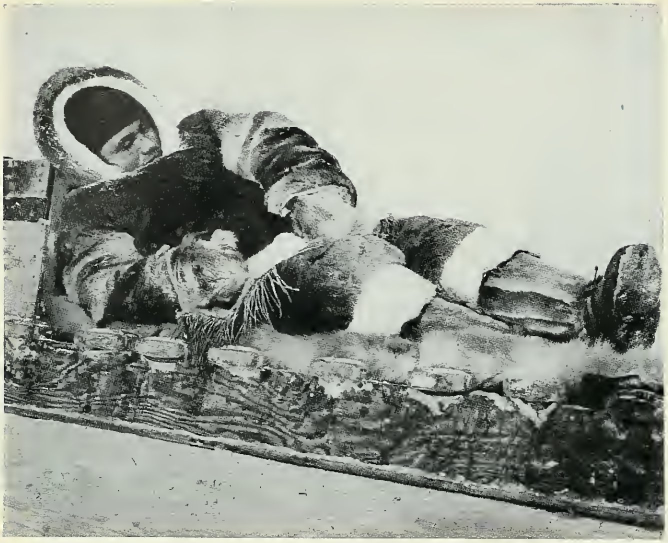
▲ HERE THE SEAMSTRESS is twisting and softening a bit of skin before sewing it



▲ SHREDDED SINEW is still used for thread in the best Eskimo garments. Long pieces can be secured from each side of the caribou's spine, as shown here



➤ SHE WHIPS THE EDGES with fine stitches, using a three-sided needle and a steel thimble. Needles were once of bone or ivory, rarely copper or meteoric iron



▲ **Propped up** to utilize the air-capture principle, the Eskimo sometimes sleeps outdoors, as shown here on his sled. If he lay flat, the chill would waken him in a few minutes

Anyone who has used clothing of the air-capture type such as that worn by the Eskimos is apt to be so impressed with its advantages that he will wonder why the air-capture system has not triumphed over the direct insulation system. One advantage is that it embodies a sort of automatic temperature control. When the wearer walks rapidly or runs, the exercise speeds up the generation of bodily heat, but it also speeds up the interchange between the air within the garment and the colder surrounding air, because the jacket flaps. This is not true with the direct insulation garment, in which exercise causes the wearer to grow hotter and hotter unless he takes off one layer after another. In spite of the many advantages of the air-capture principle, we find that the direct insulation method has been adopted by nearly the whole of mankind. How so?

Skin Side Outside

The first garment used by man for warmth was probably the skin of some beast. Fur is agreeable to the touch, and the wearer was probably quick to learn that it is more agreeable to turn the soft side in. The fur side feels warmer, because the separate hairs provide innumerable pockets of dead air, which quickly become warm from body heat. This principle was destined to be stated by Longfellow in his *Hiawatha* and to be expressed even more clearly through the following parody found in one of the books of Carolyn Wells. The verse tells how the Indian culture hero designed garments made from the skin of Mudjokiwis, the beaver:

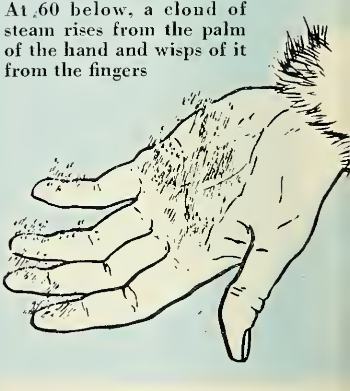
"He slew the mighty Mudjokiwis;
Of his skin he made his mittens.
He made them with the fur side inside,
He made them with the skin side outside;
For, to get the warm side inside
He put the outside skin side inside;
And, to get the cold side outside,
He put the inside skin side outside.
That's why he turned the fur side inside,
That's why he turned the skin side outside.
That's why he turned them inside outside."

A poncho-style cape, reaching from the shoulders to the calf, if made on the Mudjokiwis principle, would hold the air well enough to warm most of the body, in spite of the cape's moderate flapping. It would therefore give a sense of comfort to the entire body of the wearer at temperatures down to perhaps zero. Possibly the skirt came as an addition to a poncho-type garment. It is suspended like an inverted bell from the waist, as a cape is suspended from the shoulders.

Europeans of modern times have had little understanding of the air-capture principle, as can be seen in the writings of explorers about the clothing of southern South America. Even Darwin missed the point. The Fuegians, for example, who were naked inside their capes, were usually described as being inadequately dressed. The conclusion was drawn that they possessed astounding resistance to cold. Perhaps a different verdict would have been reached had the explorers been North European peasant women used to going barelegged inside skirts of heavy cloth.

Furs and leather have serious disadvantages, among them that with dampness they decay. So woven cloth seems generally to have supplanted fur garments, even in the colder parts of South Amer-

▼ **Moisture** is constantly leaving our bodies through the skin, but we cannot see it at ordinary temperatures. At 60 below, a cloud of steam rises from the palm of the hand and wisps of it from the fingers



ica, as well as in Europe. The use of nearly airtight skin garments of the poncho type was forgotten. Even herdsmen and farmers exposed to all weathers, and with animal hides abounding, began to prefer the use of numerous layers of porous woolen cloth.

Wool as material for clothing also has disadvantages. It is apt to be itchy; it accumulates dampness; it soils easily, and when moist and greasy, it loses its insulating qualities, though dirt and dampness do make it more windproof. When worn in many layers, it is heavy and stiff. But even with all these disadvantages, woolen garments came to be considered suitable for use in cold weather as far north as middle Europe and in corresponding latitudes of Asia. Farther north, furs supplemented woolens and were worn mainly as outer garments covering the many-layered woolens beneath. The entire outfit weighed 30 or even 40 pounds, counting everything from top to toe. These multiple layers were stiff and cumbersome, and they lost insulating power through dampness from perspiration.

How sadly impractical the European type of clothing was became evident when polar explorers used it on their long journeys far from warmed houses. When Nansen organized his justly celebrated "Fram" expedition in 1893, he provided himself and his companions with the best clothes that were devisable on the basis of Norwegian belief, as modified by his own experience during a winter in Greenland. For his midwinter sledge journey with Hjalmar Johansen, Nansen at first wore European-type furs over woolens. He tells how unsatisfactory these clothes were:

"... We soon discovered that they were always too warm and caused too much perspiration. By absorbing the moisture of the body, they became so heavy that they made an appreciable difference in the weight of our loads and on our return from three days' absence from the vessel were so wet that they had to be hung for a long time over the saloon stove to dry. To this was added the experience that when we took them off in the cold, after having worn them for a time, they froze so stiff that it was difficult to get them on again ..."

▲ **Encased in fur clothing** designed to prevent the upward escape of the warmed air, the Eskimo and white man alike can travel in comfort. The total weight of these outfits will be only from seven to ten pounds

He then shifted to all-cloth European clothing, with the addition of a hooded cotton jacket of Eskimo design, which pulled on over the head. As I pointed out in the U. S. Army's *Arctic Manual* (pages 271-273, 1940 edition), it is necessary periodically to dry certain types of winter clothing because an "invisible perspiration" is constantly coming out of the human body—a vapor which can't be seen at ordinary temperatures but which becomes visible around 30 or 40 degrees below. It grows rapidly more conspicuous as the temperature drops toward 70, 80, and 90 below. If you hold out a dry hand at 60 below, you will see a cloud of steam rising from the palm and wisps of steam from the fingers. Added to this as a source of moisture is, of course, the ordinary visible perspiration caused by exertion and too-warm clothing.

In cold weather, the point at which this insensible perspiration condenses as moisture is reached in the second or third layer of woolen clothing where the cold from the outside meets the warm "steam" and turns it into hoarfrost. If only two layers of clothing are worn at 20 degrees below, it may be that the dew point is reached outside of the second layer. Then all the hoarfrost will either float away on the air as a fog or gather exclusively on the outside of the outer garments, where most of it can be brushed off. But if the temperature drops another 20 or 30 degrees, the condensation will begin to take place between the layers of clothing, and the garments get wetter and wetter. The problem was stated by Nansen as being insoluble.

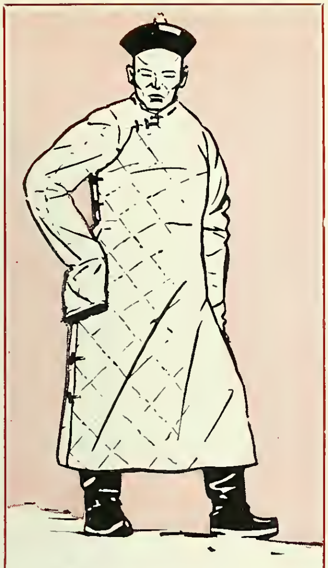
Nansen and Johansen pitched a tent each night. Outside, the temperature would be, say, 40 degrees below. When they went into the tent, the temperature would rise to possibly 10 degrees below. This change was enough to shift the melting point in their garments, and the hoarfrost in the middle of the three layers would melt. This would make that layer damp, and some of its moisture would re-evaporate and condense over again in the outside layer. The sleeping bags that they used were of two layers, and when the men crawled fully clad inside these bags, some hoarfrost melted and their clothes began to get wet. The first morning when Nansen crawled out of his bag, his clothing was damp, rather than wet. After the second night in his sleeping bag, he was nearly twice as wet. The third left him nearly three times as wet. After some weeks, the bags and daytime clothes weighed several times as much as they had in the beginning, the difference being ice. Each morning the clothes would freeze, and he had to flex the arms and legs at elbow and knee to form joints. When the freezing was complete, the clothes worked somewhat like medieval plate armor. Even as recently as the winter of 1947-48, the Canadian Army found that when they wore standard equipment weighing at the start about 25 pounds, about a pound of moisture was added each day during the first week, with corresponding loss of flexibility and warmth.

People take it for granted that the problem of keeping warm out of doors can be solved only by loading the body down and stiffening it up with layer upon layer of clothing. They then find out, as Nansen did, that they will inevitably become soaking wet, and remain so. It is commonly believed in our colder states, especially the prairie ones, that if you are caught out in a blizzard in ordinary winter clothing, you are in danger of freezing to death. We forget that it is equally well known that 1000 miles farther north on the arctic coast of North America, people caught out in the worst sort of blizzard, but wearing the local winter costume, are in negligible danger. They merely face a long and tedious spell of sitting the gale out.

Outside of North America we find an application of the air-capture principle as far south as China, where people wear sleeves extending a few inches beyond the tips of the fingers. When the arms hang downward in cold weather, the warmed air inside each sleeve holds its place around the naked hands through its own buoyancy, keeping the wrists warm and the fingers supple. The Chinese overlap their coat-type garments until they are approximately airtight. Whereas our European double-breasted coats and overcoats have an overlap of three or four inches, the Chinese carry the overlap so far around that the garment buttons in an up-and-down line beneath one arm. At the neck they have no V-cut like ours but button up snugly all the way to the throat. The Chinese have also approached the real air-capture system in not using more than one thickness of cold-weather garments, at least under some conditions. True, the air-capture principle does not work when the material of the clothing is porous. But quilting, such as the Chinese wear, will slow up the passage of warm air to the outside, and the dirtier such a garment becomes, the more it approaches airtightness. Its airtightness also increases with dampness. In Mongolia, fur cloaks are worn that are snug at the neck and extend down nearly to the ankles. If they are buttoned up with a sufficient overlap, these cloaks will enclose a single pocket of warmed air.

The Eskimo deliberately admits the coldest air into his winter clothing and his houses, then controls and uses this air after it has been raised to a tropic warmth. When an Eskimo mother travels during winter, she strips her baby naked and carries it at the small of her back, inside her shirt and supported by a belt. Ventilation is up between the mother's shoulder blades, along the back of her neck, and into her hood, where she can control it. If the child becomes overheated, the traveling party will stop and the mother will spread a skin on the snow, hair side up. Next she loosens her belt, lets the baby slide out of the bottom, and places him on his back on the skin. The child wrinkles his face, and you may think he is finding the chill disagreeable, but the mother will deny this, explaining that he is adjusting his eyes to the light. The truth of this is proved a moment later when the baby opens his eyes wider and smiles. Presently, the child manifests discomfort, and the mother lifts him up and slips him once more under her furs. At 20 below, in still air, she will have had the child out for from a half to three-quarters of a minute or even longer.

The air-capture principle in clothing is similar to the principle of the fire balloon, in which warm air produced by the burning of some inflammable material rises through an opening in the bottom of the balloon and, through its buoyancy, displaces the cooler air. The warm air, being lighter than the surrounding atmosphere, gives the balloon buoyancy. In the same way, the warm air inside the jacket of an Eskimo-style garment, warmed by body heat, has the tendency to rise, rather than flow out around the edge below. But the jacket rests snugly on the shoulders under its own gravitational weight, and this keeps the warmed air from rising easily into the hood. It follows that the Eskimo who is sitting out a blizzard does not lie down. To do so would permit the warm air to escape around the edge of the jacket. For the same reason, an injured man should not be allowed to lie flat in the cold but should be propped up at a slight angle. If he must lie flat, the skirt of his jacket should be tied around him with a belt or cord to retard the



▲ In China, the air-capture principle is used in this type of garment. The long sleeves imprison the warm air around the hands. The close-fitting neck and overlapping front help prevent the escape of the warmed air around the body

escape of the warm air. You will find that you can sit still indefinitely at 50 below zero in Eskimo clothing without discomfort; and you can sleep an hour at a time hunched forward sitting up. But if you lie flat in that temperature, retained air will escape so fast that chill will awaken you in a few minutes.

When you are on the trail, if you are exerting yourself and the flapping fringe of your jacket does not keep you from getting overheated, you can quickly adjust the temperature by allowing some of the warm air to escape at the chin by pulling your garment forward at the front of your throat.

But we learn slowly from primitive peoples. Europeans have been in close relation with the Eskimos for anywhere from 40 years around Coronation Gulf to about 400 years in Labrador. But the superiority of the snowhouse over the tent for cold weather travel has only recently been taken for granted. That dogs are the best traction animals for polar exploration could have been realized long ago, but Captain Robert Falcon Scott and his valiant men worked their hearts out pulling their own sledges as recently as 1911-12 and died practically in harness. The first explorers saw the Eskimos healthy on an all-meat diet, with never a sign of scurvy. Yet visiting Europeans continued to eat their own food and be sickly on it. It was a series of accidents, in which white men were forced to live on fresh meat, that finally convinced explorers that new meat is a preventive and cure of scurvy.

Europeans have been slow to learn about Eskimo clothes partly because to dress like a savage is plain proof of "going native." For two centuries and more, the explorers and fur traders saw the Eskimos running, walking, and sitting still for hours at a time in the coldest arctic temperatures in suits that weighed only about seven pounds for running and walking and about ten pounds for sitting still. Yet Peary was not far from right when he said in his *Secrets of Polar Travel* that "Schwatka (1878-79) was about the only Arctic traveler . . . who appears to have fully appreciated and to have known how to use fur clothing properly."

Caps Instead of Capes

The early whites in northwest Alaska were whalers, trappers, and traders, many of whom married

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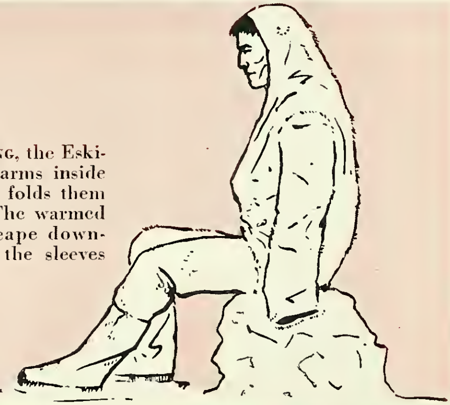
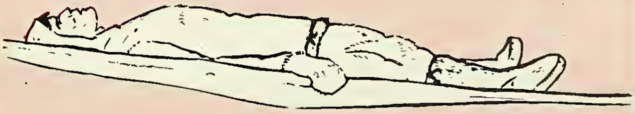
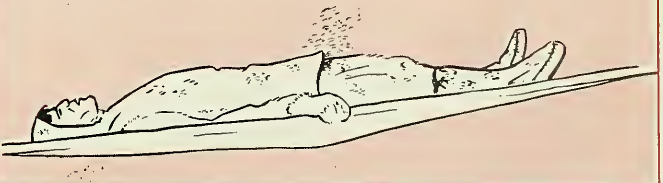
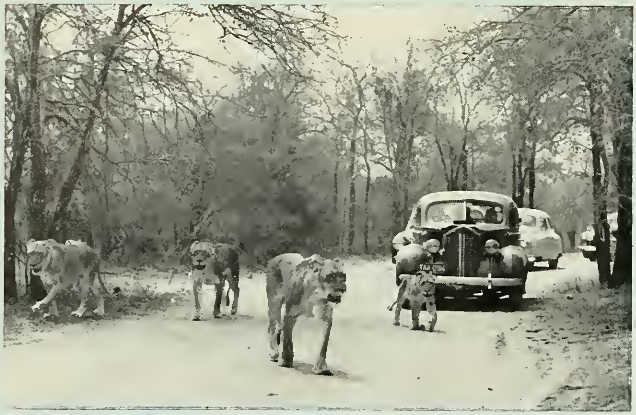


➤ When resting, the Eskimo draws his arms inside the jacket and folds them on his chest. The warmed air cannot escape downward through the sleeves



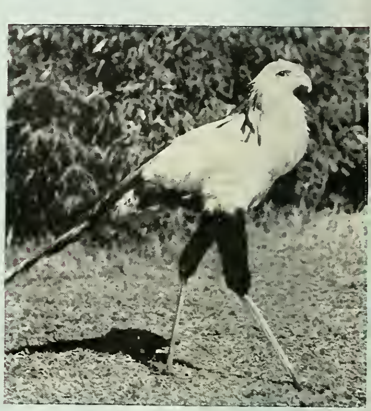
▲ A sick or wounded man wearing clothing of Eskimo design should lie with head higher than feet, because warm air tends to rise. A belt or rope around the bottom of his jacket will also help to hold in the warm air (*upper drawing*). If his feet are raised above the level of his head, the warm air will flow out and he will become chilled in a few minutes (*lower drawing*)





◀ **The lions** like to sunbathe in the middle of the road and may be in no hurry to move aside to let the tourists through

▼ **The stately secretary bird**, so named because its crest resembles a bunch of pens stuck behind the ear



Kruger's ANIMAL FAIR

Many South African animals would have become virtually extinct without this remarkable game sanctuary, now celebrating its 50th anniversary

By **Peter Holz**

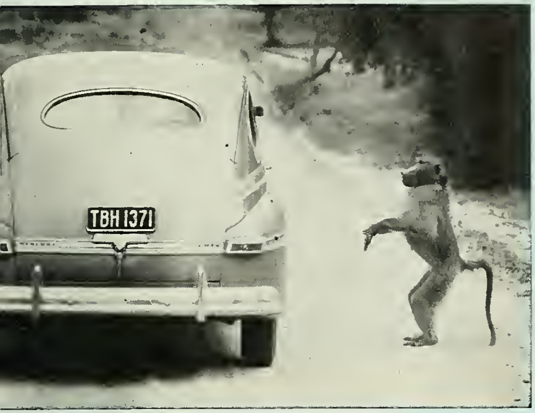
Photographs by courtesy of South African Railways

A MAN traveling with his family in Kruger National Park in South Africa once stopped his car by the side of the road to take a photograph. His wife and children got out of the car and posed in front of a thick cluster of bushes. A few days later, when the film was developed in Johannesburg, the snapshot showed, in addition to the family, a fully grown lion licking its paws in the shade of the bush, from which it apparently had emerged while they were posing for the picture.

The man's camera was the most dangerous weapon allowed in the Park. Nevertheless no serious accidents have occurred in the 27 years that Kruger National Park has been open to the public. Leopards and elephants, zebras and waterbuck, are permitted to wander freely in this area, which was originally thought of as a game reserve by Oom Paul Kruger, President of the Boer Republic. That was in 1884, but the development of the Park was held up by the Boer War, and it was not until 50 years ago, in 1904, that the area was given its first warden and named the Sabi Game Reserve. In order to give many almost exterminated animals a chance to multiply, the gates of the Reserve were not opened to the general public until 1927. Only three automobiles entered the vast territory the first season. But in 1950, 16,000 automobiles visited the Park, and the number keeps growing. Its area now is as large as all of Belgium.

The Park is a sanctuary for animals, birds, and reptiles of every description and is located only 280 miles from modern Johannesburg. It has never been fenced in, yet few of the animals will stray from its safety onto adjoining farms, where they may be shot at by farmers, hunters, or even poachers.

All guns must be declared at the entrance, where they are sealed

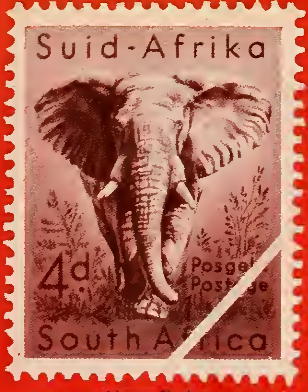


▲ THE BABOONS in the Park have learned to beg for food

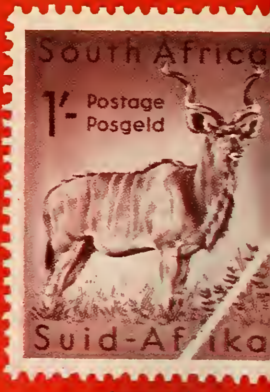
➤ A LIONESS whose main problem is the number of people who want to take her picture

▼ A WET ELEPHANT crossing the road in Kruger National Park. Visitors are urged to give these animals the right of way and not to molest them. An enraged pachyderm can reduce an automobile to a crumpled mass of metal

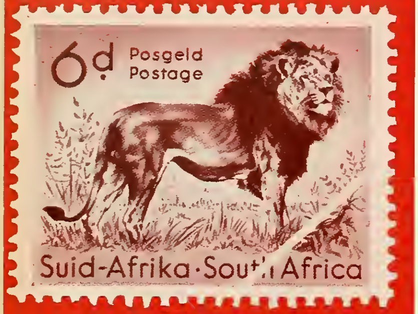
FOURTEEN ANIMALS characteristic of Kruger National Park or other sections of South Africa are depicted on a new issue of postage stamps, which went on sale in South Africa in October



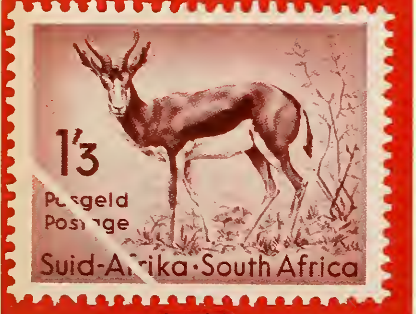
African Elephant



Greater Kudu



African Lion



Springbok

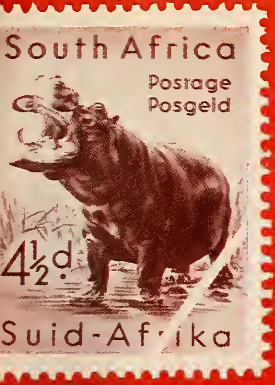
and returned only on leaving. Park officials have devised their own methods of protecting the visitors and animals from each other. Visitors are forbidden to leave the safety of their cars except after entering one of the fenced-off rest camps. The gates of these camps are locked every night shortly after sundown, and anyone not in camp by then is subject to a substantial fine.

Most of the fifteen well-organized rest camps bear unusual native names, such as Satara, Shingwedzi, and Skukuza, and they can accommodate a total of 1,500 visitors. In the near future, this figure will be increased to 2,500 to provide for the increasing number of travelers.

Admission to the Park is 10 shillings, or $1.40, a person. A night's accommodation in a spotlessly clean and well-kept hut costs 5 shillings, or 70 cents. Each camp is supervised by a European, and at some camps there are modern family bungalows, complete with kitchen, bedroom, and bath. At the larger camps there are electrically lighted restaurants, garages, and stores.

The Park is open during the South African winter, from the end of May to about the middle of October. The northern part of the Park is closed for the six-month summer season, as the roads are by no means all-weather. Six rivers run through the Park, and two of these, the Letaba and the Olifants, flood every year. As there are few good bridges, cars are more often than not forced to drive through the shallow rivers to reach the other side. In the wet season, this would be quite impossible, and motorists might well be stranded for weeks. The Park has been declared malaria-free, but in the wet season there is still danger, as mosquitoes capable of carrying the disease do exist, though they are not actually infected. The heat of the summer months, furthermore, is unbearable for many local and overseas visitors. I recall a temperature of 115 degrees F. in the shade on the last day of the open season in October, 1950.

The best months for seeing the game are August, September, and October. The animals become more concentrated as the dry season advances. The area is crisscrossed with good sand roads. While driving through the thorn forest or among the deciduous trees and subtropical evergreen groves, mammals, birds, and reptiles in great variety may be observed. Among the mammals you may see everything from the small dassie or rock rabbit to the largest of all living land animals, the African elephant. Unlike his more docile Indian cousin, the African elephant is unpredictable, and visitors are advised to stop their car immediately and keep the engine running, lest one of the pachyderms should decide to cross the road too close to the vehicle. An occasional visitor of an objectionable type has been known to shoot at an elephant with a slingshot at fairly close quarters from a car window, little realizing that once an infuriated African elephant charges, one's chances of survival are absolutely nil. I myself have seen a man get out of his car to pelt an elephant with unwanted or spoiled oranges. These huge creatures, despite their bulk, are able to move with surprising speed and can overturn a car or trample it down to a tangle of wreckage about two feet high. Particular care should be exercised in the neighborhood of elephant cows and their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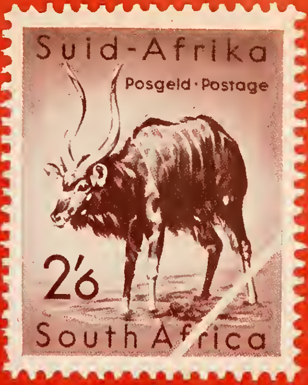
Hippopotamus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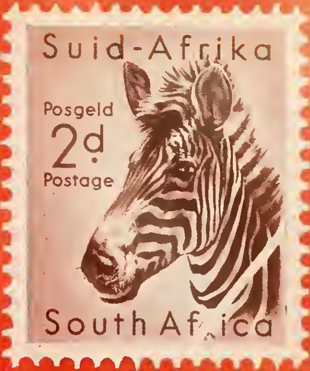
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Zebra

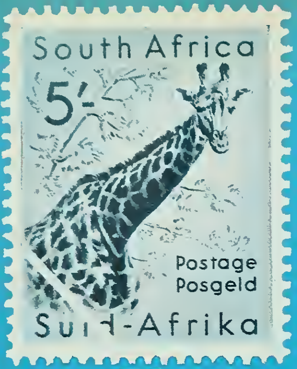
young. Bull elephants on their own are usually far more docile, but here again, one never knows!

Elephants had practically disappeared from the part of northeastern Transvaal in which the Kruger National Park is situated; however, many new ones have entered the Park from Portuguese East Africa, which forms the entire eastern border of the reserve. As a result, elephants have multiplied rapidly in the last few years and have on occasions become a problem to the authorities. They have recently broken down camp fences at night to feed on young tree shoots just outside the visitors' huts.

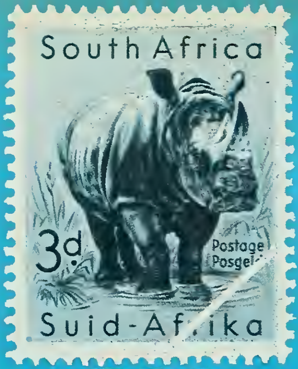
▲ THREE CHEETAHS lying unconcernedly in the road

◀ AUTO COURT á la Kruger Park: visitors' huts at Pretorius Kop Rest Camp

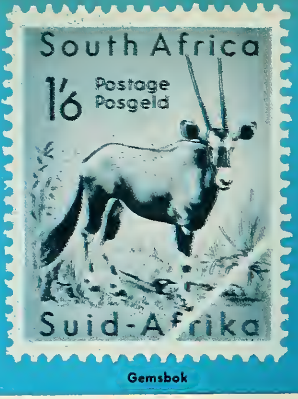
➤ TRAVELERS preparing their midday meal in Skukuza Rest Camp. Fifteen such camps in the Park accommodate a total of 1500 visitors, and the capacity will soon be increased to 2500



Giroffe



White Rhinoceros



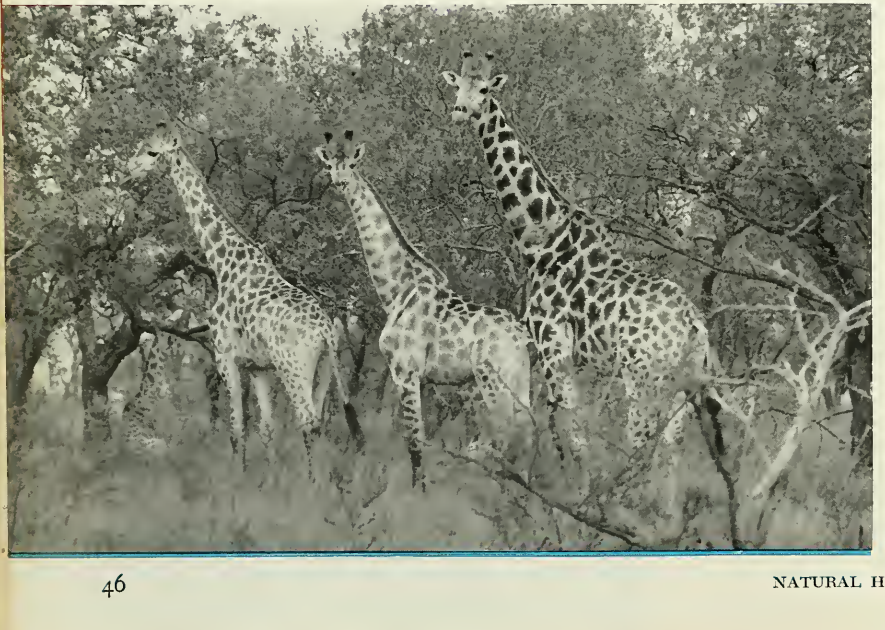
Gemsbok

The wart hogs are called by the Zulus "small elephants," presumably because their curved tusks give them a slight resemblance to their powerful namesake. They make their homes in burrows, which they are in the habit of entering tailfirst. Thus, their hind quarters, which are a great delicacy among carniverous animals, come out last, not first.

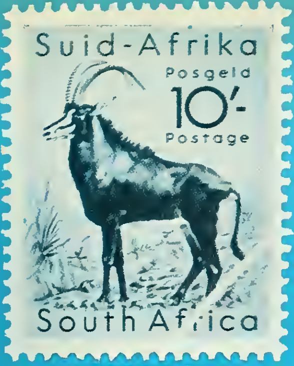
The animals of the Park are so used to visitors that they will sometimes refuse to move off the road. This is particularly true of whole families of lions, which love to sunbathe right in the middle of the road. When the circular huts or bungalows provided for visitors are full to capacity, as occurs in the more popular months of the year, it is not unusual for the overflow of tourists to sleep in tents. On one memorable occasion, visitors had the additional thrill of a lioness brushing against their tent and growling angrily as she hit one of her paws on a tent peg. The animal had somehow penetrated the fence protecting the camp.

It has been borne out by many game wardens that lions are more or less harmless during the day. This belief probably accounts for the fact that one sometimes sees an unarmed native trotting the dusty roads. At night, lions become much bolder and will attack human beings if given the opportunity. Lions are the largest carniverous animals in Africa and usually feed on zebras, gnus, and other antelope of the region. Cases of cannibalism have even been recorded. Lions will never attack the rhinoceros or hippopotamus, and they rarely if ever attack the giraffe.

The giraffe is perhaps the most striking animal in Kruger National Park. Tallest of the mammals, adult bulls may reach a height of 18½ feet. Both sexes possess small skin-covered horns and are believed to be entirely silent, though some authorities claim that these creatures have been known to "moo" softly in captivity. Giraffes are capable of attaining a speed of 35 miles an hour. They run by moving the fore and hind legs of the same side



◄ VISITORS are invariably entranced by a close-up view of Kruger Park's giraffes, some of which reach a height of 18½ feet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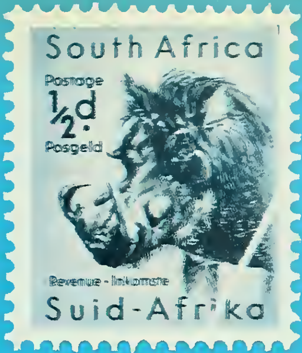
Sable Antelope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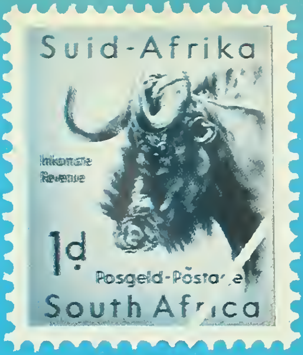
Wart Hog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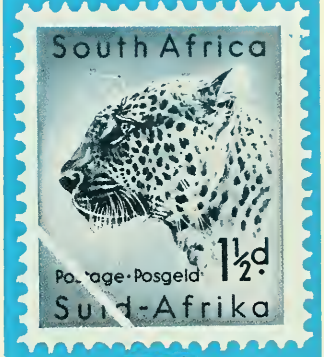
White-Tail Gnu

simultaneously, causing a most peculiar rolling motion, accompanied by a swaying from side to side of the long neck. The tapering tail is carried bent forward over the back.

The whole of southern Africa is generously endowed with antelopes, and no less than seventeen varieties are seen in Kruger National Park. Hardly a minute passes that one does not see kudus, impalas, waterbuck, and the blue gnu. Birds of many sizes and colors dazzle the visitor's eye. Crested cuckoos, rainbirds, partridges, guinea fowls, and fork-tailed drangos are among the varieties.

It would be impossible to do more than touch on the whole story of this game reserve here. The many travelers that have entered the Park bear testimony to its worth-while attractions. From the comfort of your car, you can see Africa as it was in the days of Livingstone and Cecil Rhodes. No other game reserve in Africa can claim the great number of tourists that Kruger National Park has had since its beginning. Without this Park, a great number of the animals would be virtually extinct in southern Africa today; and the enjoyment and education that the many visitors derive from it would have been impossible but for the foresight of a small number of men who, many years ago, saw the need.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Leopard

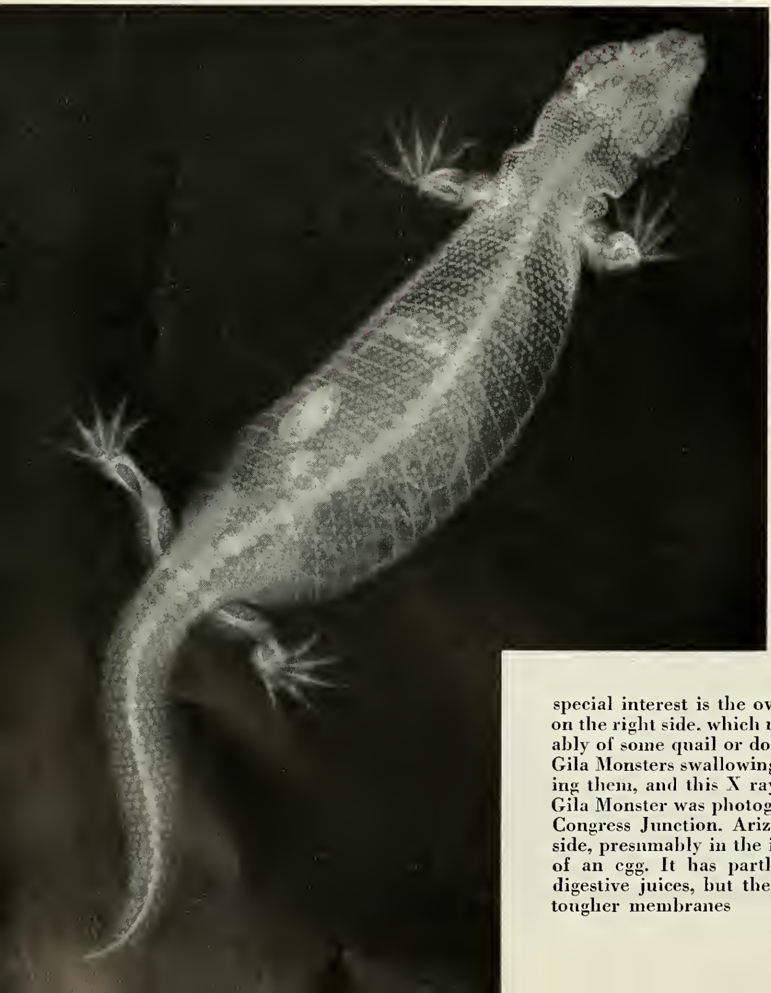
➤ ZEBRAS AND GNUS are sometimes seen in great numbers at the waterholes

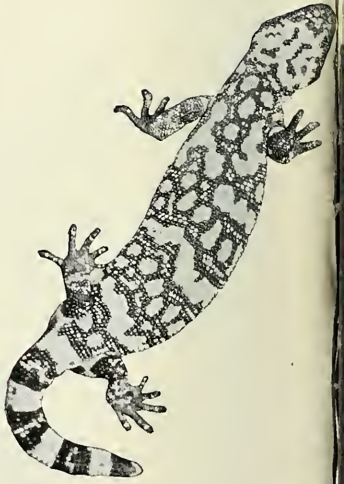
Desert Dwellers—INSIDE and OUT

X—RAY photography gives a new view of them

By Charles Franklin Parker

Camera and X-ray photographs by Charles A. Leake





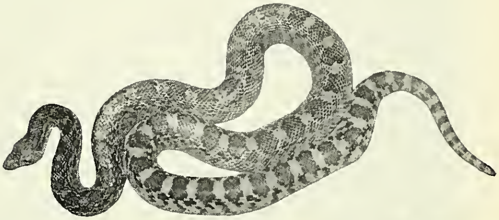
◄ As this X-ray view shows, the Arizona Gila Monster (*Heloderma suspectum*) possesses, in addition to the usual internal skeleton (endoskeleton), an easily recognized "skin armor," or exoskeleton. This latter is clearly evident here in the form of innumerable little dots representing "skin bones," or osteoderms, in the beaded covering that anyone remembers if he has seen this animal. Of special interest is the ovoid outline in the position of the stomach on the right side, which may well represent an undigested egg, probably of some quail or dove. There are a few independent reports of Gila Monsters swallowing the eggs of Gambel's quail without breaking them, and this X ray may provide confirmatory evidence. The Gila Monster was photographed 48 hours after it was captured near Congress Junction, Arizona. The more opaque object on the left side, presumably in the intestine, is apparently the calcareous shell of an egg. It has partly collapsed, probably from the effect of digestive juices, but the harder fragments are still sticking to the tougher membranes

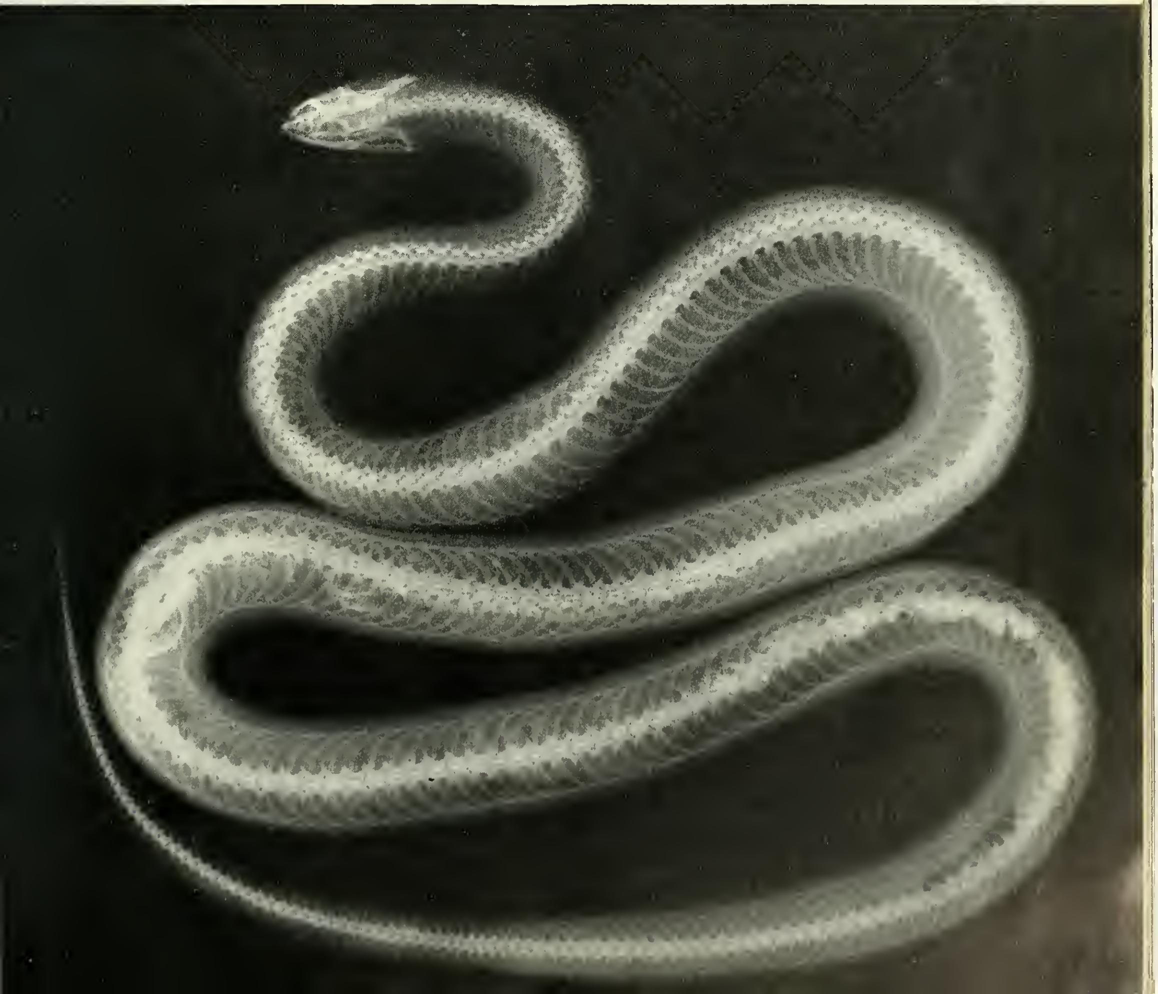
EVER since the time I was required to make drawings of animals from laboratory dissection, I have been most curious about the actual skeletal structure of small backboned animals. When I saw these X rays that Charles A. Leake made of some of our Arizona desert dwellers, I was thrilled in the fulfillment of my long-awaited opportunity.

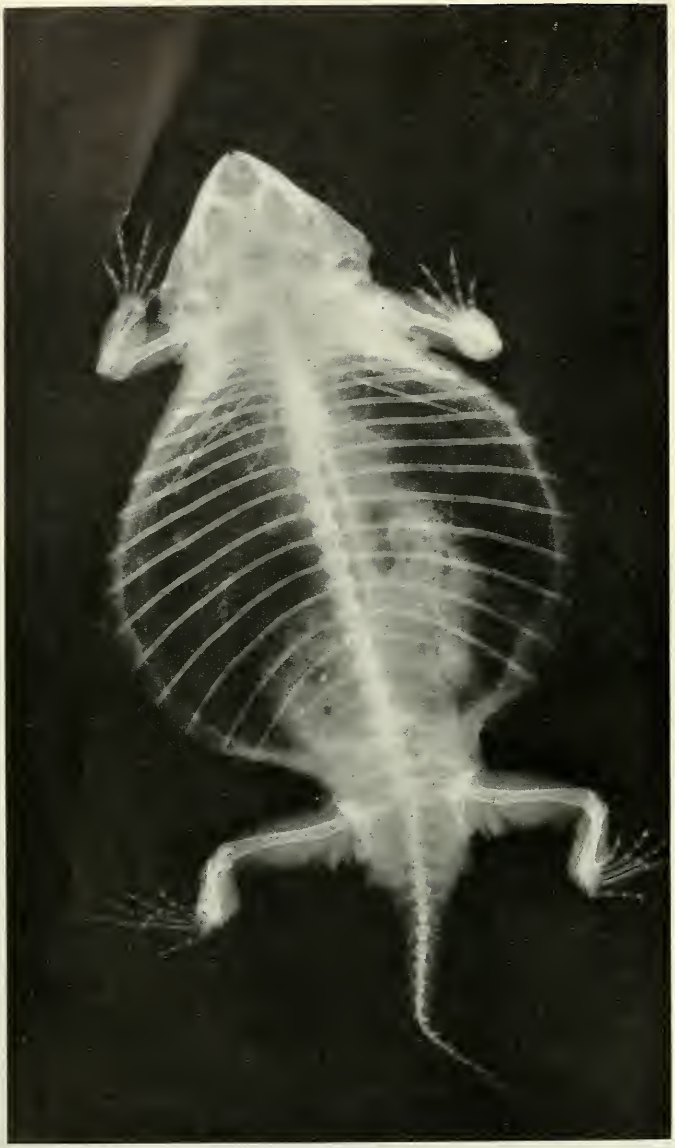
For many years medical science has used X ray for the diagnosis of human ills. Now the day may be approaching, with the emphasis upon visual aids in teaching, when the fruits of such techniques as these will be in more general use, both in classrooms and museums.

This procedure involves something more than the usual photographing of animals in their natural habitat. For X rays, the specimens must not only be captured but specially prepared. According to Mr. Leake, his procedure with these cold-blooded animals is to cool them by refrigeration to the point of reducing but not stopping their activity, so that they will remain relatively immobile for the seconds required in taking the X-ray picture. After the picture has been taken, the

▾ THIS X-RAY VIEW of a Bull Snake, photographed while the animal was still alive, shows clearly the snake's skeleton. In the loop farthest to the left can be seen the remains of a small rodent that the snake has eaten. The rodent's head is in the region where the semicircular white area is visible. The bones of the rodent's spinal column extend to the right, parallel to those of the snake. The snake was about six feet long







THESE TWO PICTURES SHOW the Mountain Short-horned Lizard (*Phrynosoma douglassii hernandesi*). The X ray reveals the little fellow's skeleton in all its details—vertebrae, ribs, breastplate, bony structure of the head, leg bones, and well-formed pelvic girdle, as well as the outline of the internal organs

animal can be kept until the plate has been developed. If necessary, the specimen can then be re-refrigerated for another try.

This process requires access to X-ray equipment and a knowledge of X-ray techniques. Most communities have the equipment, and it should not be difficult to interest a trained technician. The accompanying X rays had special handling by the Eastman laboratories, and they certainly show very satisfactory results. I have been informed that they were made for the particular purpose of testing X-ray film for fine detail.

I cannot but believe that the use of this technique would be valuable for instructional purposes. A library of slides might be developed from which schools could rent or borrow examples for classroom use. Museums may also find ways in which X-ray views can add to the clarity of their exhibits. Or somebody may be encouraged toward a new hobby—that of collecting X-ray views showing the bony architecture of widely differing animals.

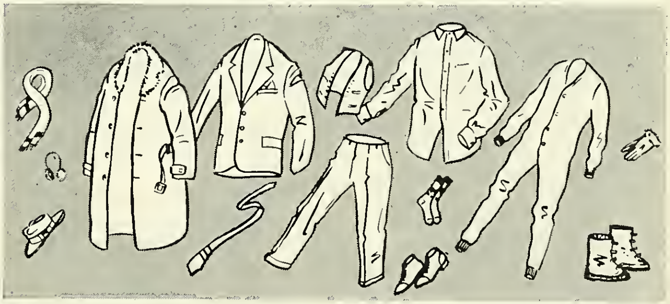
continued from page 41

Eskimo women and wore clothes of Eskimo type. But when 10,000 Europeans wintered around Nome in the 1900 gold rush, the newcomers incorporated "improvements" in the Eskimo clothes. They directed the Eskimos to make the hoods large enough to accommodate fur caps inside them. This meant that any warm air that came up into the hood would be lost where the hood bulged out. They also decreed that the Eskimo shirt be split for buttoning up and down the front, again giving ready escape for the warmed air. They were used to trousers with a fly and likewise introduced this change. In their "improved" garments, the miners thought they were dressing like Eskimos, and, feeling cold, they concluded that white men are not as "warm-blooded" as Eskimos. When the whites told the Eskimos these were better styles, the Eskimos even began to adopt the new fashions—caps, buttons, underwear, and linings.

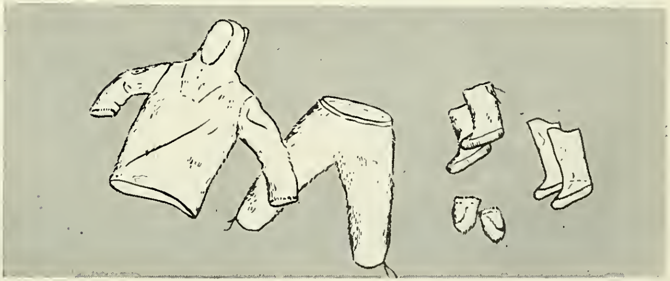
Even whites who used real Eskimo clothing sometimes made the mistake Amundsen warned against: using underwear beneath fur shirts. As Amundsen points out, "Wool underclothes gather all the perspiration and soon make a skin garment outside them soaking wet. . . . Dressed entirely in reindeer fur, like the Eskimos, and with the clothing loose enough to let the air circulate between it and the body, one will, as a rule, keep the clothing dry." However, Amundsen does not seem to have realized that the *nonpreventable* wetting of European cold-weather clothes is not due to perspiration so much as transpiration—invisible moisture in the air next to the body, which can pass out through the inner warmer layers of clothing to be precipitated later in the colder outer layers.

It was perhaps Gudmund Hatt (in a monograph in Danish, *Arctic Skin Clothing in Eurasia and America*, 1914) who first pointed out that without the air-capture garment, the Eskimos and other Eskimolike peoples could not have occupied arctic lands. He explains how the poncho-type garment may have evolved into the Eskimo jacket with hood and sleeves to permit human existence in districts that had previously been uninhabitable. As Peary said in 1917, "The face opening in the hood is made just large enough to allow the hood to be pushed back from the head in calm weather. Around this opening is a roll of soft bearskin . . . to prevent the entrance of cold air or the escape of warm." Preventing warmed air from escaping too soon is the essence of the air-capture idea. Peary also mentions the large armholes for drawing the arms inside and the importance of no buttons, hooks, toggles, lacings, or fastenings of any kind.

This, then briefly is the situation at present. Civilized persons in the arctic, be they civilian or military, cling to a direct-insulation type of garment that came down to us from medieval Europe, instead of taking advantage of the Eskimo principle of air-capture. The European style of suit weighs about 15 pounds if intended for walking at three miles an hour, and about 25 pounds for sitting still for an hour or more. The corresponding Eskimo style weighs 7 and 10 pounds, respectively. The European suit picks up a pound of moisture a day for at least the first week. The Eskimo style remains dry and flexible. Getting dressed from nakedness at low temperatures, the European style suit requires 15 to 30 minutes. From one to two minutes are enough for getting into the Eskimo-style suit. At 50 degrees below zero, the European-style clothing fails. From that point on, a man can no longer perform outdoor work but must spend practically all his energy to survive. The Eskimo style of clothing at that temperature permits regular work or play without marked lowering of efficiency.



THE OUTFIT that a man might wear in our North Central States would weigh from 25 to 30 pounds, and getting dressed takes him about 15 times as long as it does an Eskimo



▲ **The fish** are lured within camera rang
submerged photographer. "Hunters of the
presents spectacular underwater scenes in

◀ **Down under** with
a Giant Sea Bass

The Screen Authoritative comments on films in the field of nature, geography, and exploration

Edited by Elizabeth Downes

Hunters of the Deep

Reviewed by James W. Atz
Assistant Curator, New York Aquarium, New York Zoological Society

For moving pictures like "Hunters of the Deep," we must thank the recent improvement in color film and cameras and the development of new techniques in diving. And grateful we should be because, as this movie makes clear, it is now possible for all of us to get acquainted with the world beneath the sea, a place so different from the one we inhabit that it almost defies description and must be seen to be believed.

Underwater seascapes are outstandingly beautiful, sometimes eerie, sometimes soothing, but never exactly what you might expect. The forests of giant kelp, the meadows of lesser seaweeds, and the crags of coral that comprise this film's setting all have an unearthly quality, both literally and figuratively.

"Hunters of the Deep" provides exceptional opportunities to see such wonders as whole schools of hammerhead sharks and manta rays, the jet propulsion of an octopus, the feeding posture of the great basking shark, the unique locomotion of the ocean sunfish, the peculiar fish-catching of the squid, sea elephants gamboling *under* the waves, and a bird that uses its oversized feet to dart through the water like the caricature of a drunken Charlie Chaplin. Even the commonplace California sea lion performs fabulous feats with agility and grace, impossible to see as long as the animal is viewed from above the surface. Equally surprising are the histrionics of two large groupers, acting under the influence of "cupboard love."

With so much that is worth while in the film, the producers of "Hunters of the Deep" may perhaps be excused for the several factual errors in the commentary as well as its lapses into those Hollywoodian clichés that few nature films seem able to escape. No one will greatly mind the mixing of a few West Indian sequences with those taken off the California coast, but I for one strongly objected to the poorly contrived scenes that tried to make a first-class menace out of an inquisitive shark that eventually turns out to be hardly more savage than the two gluttonous groupers mentioned above. The title of the picture is also one of these clichés, for there is a great deal more than hunting in it.

"Hunters of the Deep" is being released by Distributors Corporation of America.

▲ FROM "THE PURPLE PLAIN." Gregory Peck, acting the part of an air force pilot, and his wounded companion are stranded on an alkaline flat in Burma

The Purple Plain

Reviewed by GEORGE G. GOODWIN
Associate Curator of Mammalogy
American Museum of Natural History

"THE PURPLE PLAIN" vividly portrays man's struggle against the elements. The place is the Burmese jungle, and the time is the Second World War. Gregory Peck, playing the part of an Air Force pilot, has a forced landing deep in enemy jungle territory. Encumbered with a wounded comrade and a doubting passenger, he relentlessly pushes through the barren wastes with little water and no food and eventually gets assistance from friendly natives.

The marked absence of wild animals in the overpowering heat of this flat, waterless Burmese wilderness is correctly represented. The tree growth in such areas draws its moisture from seasonal rainfall.

Brief comments on films

Documentary and Grade A	**What the Experts Said**
African Adventure Primarily concerned with the hunting and killing of animals	Will appeal primarily to sportsmen
The Vanishing Prairie A Disney film dealing with the vanishing wildlife of the American Prairie	Exciting, instructive, and highly entertaining
Down the Alphabet	
Beachcomber Based on Maugham's "Vessel of Wrath"	Drama in a tropical island paradise. Without anthropological significance
Quest for the Lost City Adventures of the Lambs during their quest to discover a lost Maya city	Incredibly contrived piece of nonsense
Sitting Bull Story of the Sioux Indian leader	Sitting Bull, General Custer, and history in general are massacred in heap big horse opera
West of Zanzibar Ivory poaching racket in Africa	Filmed on location, shots of big game, fishing scenes

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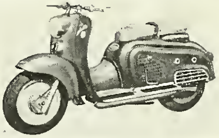

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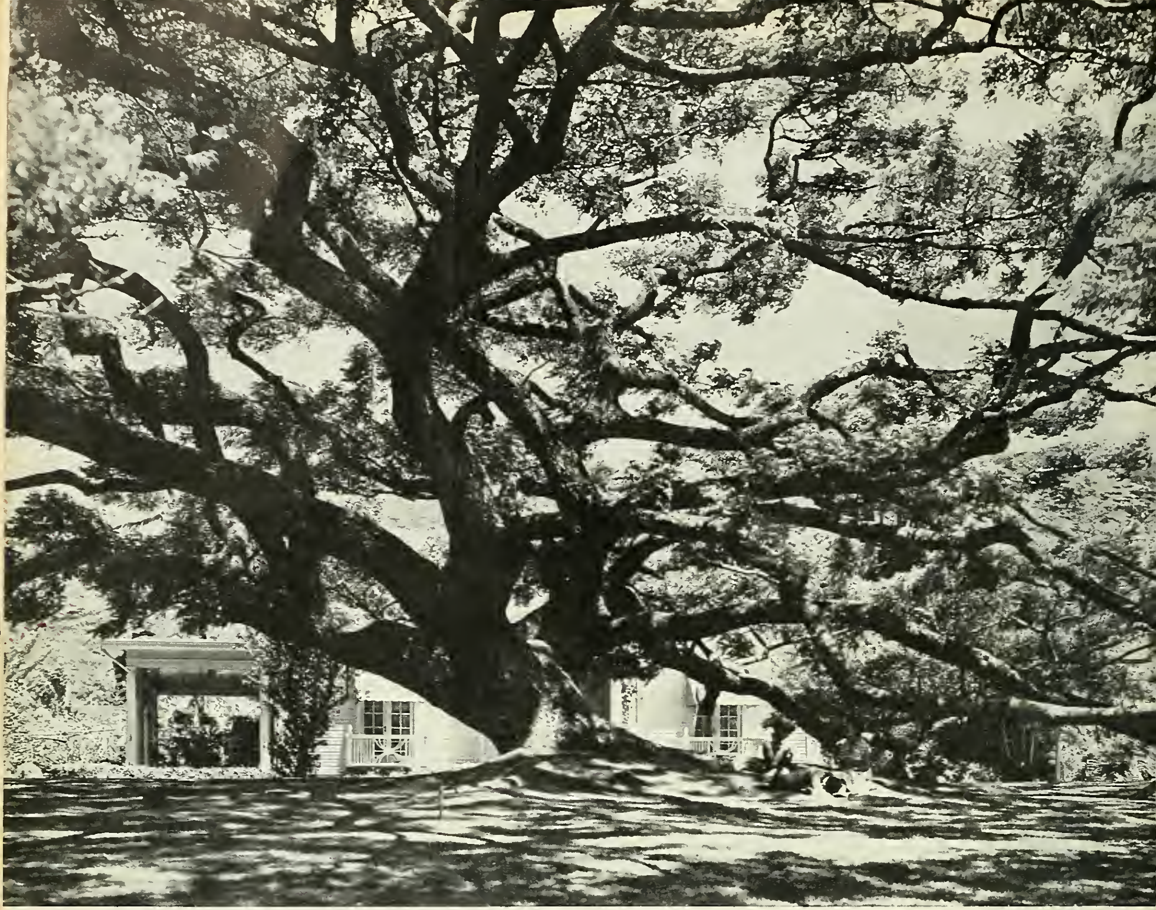

Hawaii Visitors Bureau Photo

▲ **A monkeypod tree that covers the lawn of a Honolulu residence in Nuuanu Valley**

The Monkeypod Tree

By DANA RODRIGUEZ

MONKEYPOD seems a ridiculous name for the magnificent tree in this picture. The tree is also called the Rain Tree, because it is supposed to exude water from its leaflets. This belief is erroneous. The peculiar appearance of the tree results partly from the fact that its leaves ordinarily form a dome-shaped canopy one layer thick. Another peculiarity is that the leaves close in late afternoon for the night, and also on cloudy days.

The Monkeypod is a native of tropical America, where its green or black seedpods are fed to cattle. The pods contain many brown seeds.

The tree was introduced successfully in the Hawaiian Islands in the nineteenth century by the noted Spanish horticulturist Don Francisco de Paula Marin. One of the trees was planted by Mark Twain in Kau, where it has become a landmark.

The monkeypod belongs to the bean family (Leguminosae), and its scientific name is *Samanea saman*. It rivals the Elephant's Ear Tree in spread and stature, rapidly reaching its full height of 80 feet or more, especially if grown near water.

The wood is popular for handmade craft ware, especially platters and bowls. It is tough, lightweight, and dark in color. Beads are made from the dried brown seeds. If you are interested in recognizing odd trees, this one is fairly easy to identify, especially if you familiarize yourself with its tufted flower heads, with their long pink stamens, which dot the leafy canopy in May and June.

LETTERS

Snakes Alive

SIRS:

As a native son of northern Colorado, I have known something of the habits of rattlesnakes and have attempted to learn how they reproduce. A recent experience was enlightening, and I want to ask if my observation is in keeping with what others have found.

A friend and I were visiting a local archaeological site when we saw a rattler disappearing into a crevice in the bank of an arroyo. With a shovel I uncovered the snake and killed it. Noticing that its 30-inch body was uniformly distended, I opened it and found nine young snakes. They varied in color from opaque brown to immature semi-transparent types in which portions of the anatomy could be distinctly seen. The darker ones were very active, and each tail was tipped with a button; the lighter ones were rather dormant. All were about six inches in length. The body of the adult was filled with a translucent gelatinous material, and in addition to the young, there were two spherical bodies resembling egg masses.

Is this number of young normal? How do the young leave the mother's body?

ROY G. COFFIN,
Geology Section,
Chemistry Department
Colorado Agricultural and
Mining College,
Ft. Collins, Colo.

The following comments are offered by the well-known snake expert, Charles M. Bogert, who is a member of the Scientific Staff of the American Museum of Natural History:

Dr. Coffin's observations are quite in line with what is known of reproduction in rattlesnakes. But observations such as his have sometimes given rise to the belief that snakes swallow their young for protection. Incautious observers may fail to distinguish between the oviduct and the digestive tract, in which the young snakes would have to be if they had been swallowed. No one has yet found a snake with any number of young of its own species in the digestive tract. Nevertheless, the myth persists, probably gaining impetus when observers not so careful as Dr. Coffin find unborn snakes within the body.

In common with the majority of the pit vipers, rattlesnakes retain their eggs within the body until the young are fully formed inside the transparent membranes that enclose the eggs after they reach the oviducts. Nor are these the only snakes that keep the developing eggs within the body. In the United States, all garter snakes, water snakes, and their relatives, not to mention the boas, follow this procedure. Some sea snakes also give birth to living young.

In the United States, most snakes mate in the early spring, though occasional autumn matings have been reported. The male germ cells are transferred to the body of the female at that time, but the male cells may not immediately fertilize the eggs. The spermatozoa do not penetrate the eggs until the latter have passed from the ovary into the oviduct. In some instances, a female snake may not need to mate again for four years. It is not unusual for one egg or so in the snake to go unfertilized. This accounts for the two "spherical bodies resembling egg masses" that Dr. Coffin observed.

If the rattlesnake he killed was in Colorado, it was probably a race of the Prairie Rattlesnake, *Crotalus viridis*. In the cooler sections of its range, the better part of two years is required for the incubation of the fertilized egg. Rattlesnakes usually give birth to their young during the late summer or early fall; but at higher altitudes or latitudes, the necessary development may not have taken place till the second summer or fall.

When the embryo has completed its development, the young snake, enclosed in the transparent egg covering, is expelled through the vent from the parent's body. Upon exposure, the young snake struggles to free itself and usually manages to thrust its head through the membrane within a few minutes. After that, it is left to shift for itself, and in the case of rattlesnakes the young are fully equipped with fangs and venom. Thus they are ready to kill the small mammals or lizards upon which they commonly feed.

SIRS:

My first number of NATURAL HISTORY Magazine came a short while ago, and I wish to tell you how much I am enjoying it, as are the rest of the family.

It is a fine publication, and I am delighted to have it.

JEAN ROBINSON FLEMMING
Charleston, S. C.

SIRS:

. . . I derive the greatest pleasure from your magazine each month and congratulate you on it.

S. H. WILLIAMS
Lynchburg, Va.

Forest Fires

The average citizen, if he were asked to guess the number of forest fires in a year in our country, would probably not be apt to come close to 154,160, but that is the official number for 1953. Furthermore, this is the lowest number that has been reported in the United States since 1946.

Be careful of your cigarettes while driving and of your campfires.

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continued from page 5

though it may later develop wings, as in the silverfish or grasshopper.

After learning about such things, we pass on to egg-laying and discover that there are insects that give birth to living young; and that there are flies—the tse-tses and bird lice—that nurture their young in their ovaries and deposit full-grown maggots that pupate very soon after being delivered by the female. It's an interesting tale, but rather too incomplete to be amazing.

Among the 22 chapter headings are "Nests and Nurseries," "Leaf Folders and Rollers," "Giants and Dwarfs," "Camouflaged Insects," "Pious Frauds of the Insect World" (chiefly preying mantids), "Insects in the Water," and "Courtship Wiles and Rituals."

The book is packed full of facts about strange, as well as well-known facts about insects, and any entomologist who reads it is certain to discover many things that he has overlooked in his studies. It is evidently the result of prodigious reading, and many authors are quoted; but there is no bibliography to indicate the source of the information. Scientific names are not used in the text unless no common name is available: a list of common and scientific names is included just before the index.

An American reader, unless having lived a long time in Britain, will not recognize the common names applied to insects common to England and America. We are told that we call the preying mantis a rear-horse, but you cannot find "rear-horse" in the index. The same is true of many other insects mentioned in the text.

Despite the fact that the book deals with insects from most parts of the world, it is essentially a book on British insects, and it will prove rather heavy reading to those who are not serious about learning both usual and unusual things about these creatures.

C. H. CURRAN

MUMPS, MEASLES AND MOSAICS

- - - - - by Kenneth M. Smith and Roy Markham

Frederick A. Praeger, $4.00
160 pp., 25 photos, 10 diagrams

THIS little book provides a wealth of information authoritatively written about viruses and the diseases they cause in man, other animals, and plants, including the bacteria. The authors are distinguished leaders in the virus field with special competence in plant and insect virology and in virus biochemistry. They have written in greatest detail about plant and insect viruses and virus diseases, yet sufficient information on a comparative basis about viruses affecting man and higher animals has been included to make a balanced book. As a matter of fact, this is perhaps the best popular presentation of the virus field as a whole.

Throughout most of the book, information about animal and plant viruses is blended together with skill and with proper emphasis on basic properties rather than on the kind of host affected. While it is true that there is no mention of some important viruses such as those causing hog cholera, fowl leucosis, and poliomyelitis, this cannot be criticized since it would be impossible in a small book to treat individually the hundreds of viruses that are now recognized.

This reviewer does regard as unfortunate the fact that, although pictures of crystals of tomato bushy stunt, turnip yellow mosaic, and tobacco necrosis viruses are included, there is no picture of the crystals of the historically important tobacco mosaic virus.

The book contains 13 chapters and is illustrated with 25 photographs and 10 diagrams. References to pertinent scientific literature follow at the end of most of the chapters. The final chapter describes some simple techniques, which interested readers could follow to do some simple experiments with plant viruses. There is a glossary of terms and a table giving information regarding tests for some common plant viruses. The general reader will find parts of the book rather hard going, but scientists and especially those biologically and medically inclined will find the book to be fascinating reading. The book should also prove of considerable value to any novice seriously interested in learning about the virus field.

W. M. STANLEY*

Nobel Laureate in Chemistry, 1946.

THOREAU

- - - - - - - - by William Condry

Philosophical Library, $3.00, 114 pp.

THE fame of Thoreau continually grows. He has been the subject of numerous biographies between Emerson's fine essay, read at his funeral in 1862, and Canby's definitive life, of 1939. This new and brief account by a British writer is fresh, understanding, and admirably sympathetic.

Thoreau was not the best naturalist of the American tradition, but he was the greatest thinker among American naturalists. He was as inspired and uncompromising in his writing as in his Spartan living. Dying at 45, with but two books published, his journals and other works were subsequently issued in 20 volumes.

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R. C. M.

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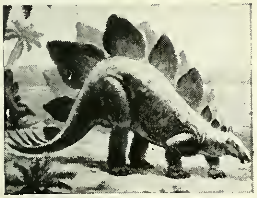

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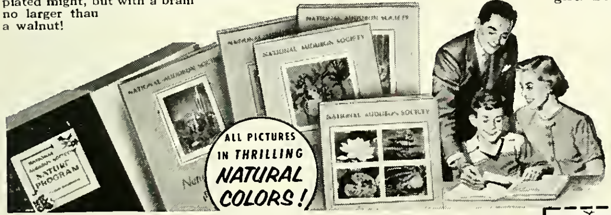

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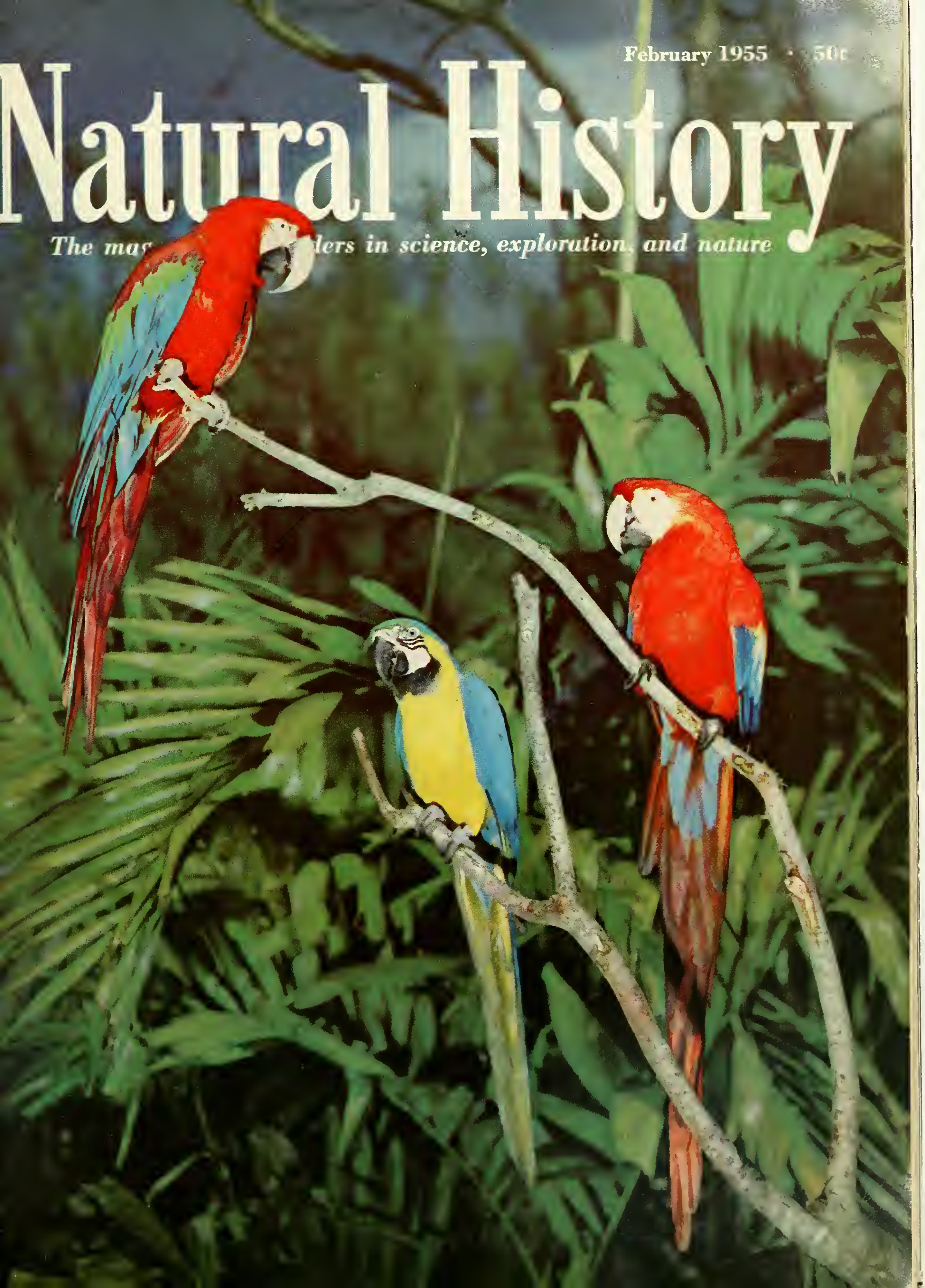

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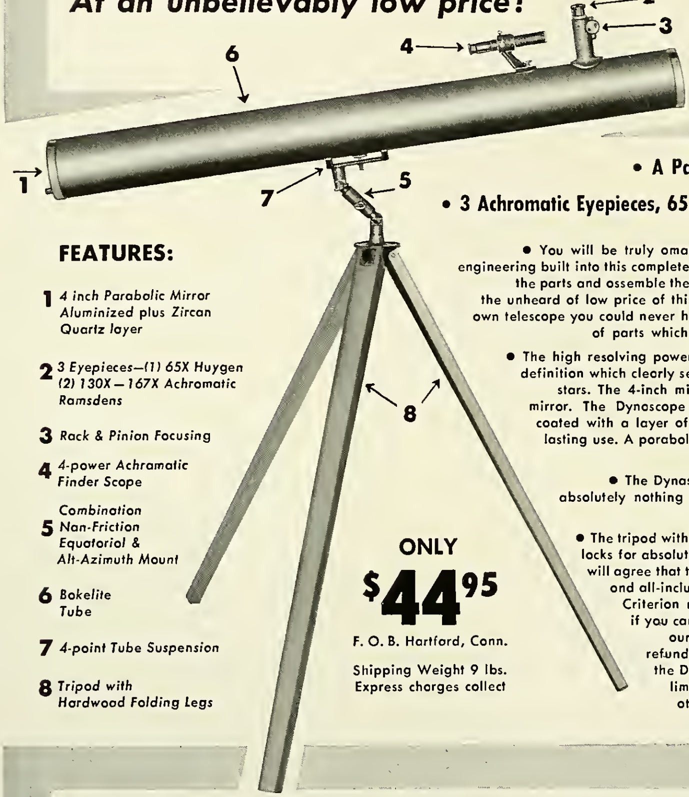

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Photo by P. Trelowny

▲ A Sooty Mangabey, a tree-dwelling, fruit-eating monkey of West Africa

LETTERS

Petrified Trees Vandalized

Sirs:

Since my article on the fossil forest in northwestern Nevada appeared in Natural History Magazine (December, 1953), there has been a lot of vandalism as a result of numerous so-called "rockhounds" visiting the area.

Upon learning of the rumored damage, Col. Thomas W. Miller, Chairman of the State Park Commission, traveled to the region in company with two members of the State Highway Patrol. They found that the remains of petrified trees had been systematically torn down and carted away from at least three locations. Bulldozers had been used to uproot three of the finest petrified tree specimens in the whole area. One measuring over twelve feet across at the base had been despoiled and was in a hollow excavation some 30 feet in diameter. Mining claims had been filed over the entire area. Colonel Miller put up a sign reading:

PENALTY
MISDEMEANOR
$10-$500 FINE
30 DAYS TO SIX MONTHS
FOR REMOVAL OF PETRIFIED TREES
Chapter 210, Nevada Statutes of 1953

I have revisited the petrified forest twice since publication of the article, and

continued on page 107

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The Magazine of the American Museum of Natural History

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February, 1955 Volume LXIV, No. 2

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From a color transparency by A. C. Shelton

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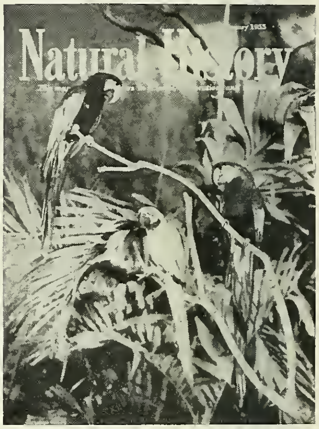
You will find Natural History Magazine *indexed in* Reader's Guide to Periodical Literature *in your library*



THE COVER THIS MONTH

The brilliant macaws—giants of the parrot family—are a natural for color photography. Shown here are three different species, a Red and Yellow Macaw at the left, a Scarlet Macaw at the right, and a Blue Macaw in the center of the stage. Macaws are found only in the tropics of America. These were photographed in an outdoor Florida aviary. Macaws are frequently seen in small flocks flying above deep canyons, often near waterfalls. They nest in crannies in the rocky cliffs or in holes in the towering trees of the jungle. The voice is guttural and hoarse, and macaws seldom become good talkers.

Their food is tropical fruits and nuts. Even tough Brazil nuts are splintered without effort by the vise-like bill. The fragments are then held in the foot while the kernel is skillfully extracted with the fleshy tongue.

One species of macaw, now extinct, lived in Cuba, while another, the green Military Macaw, ranges north well into Mexico.

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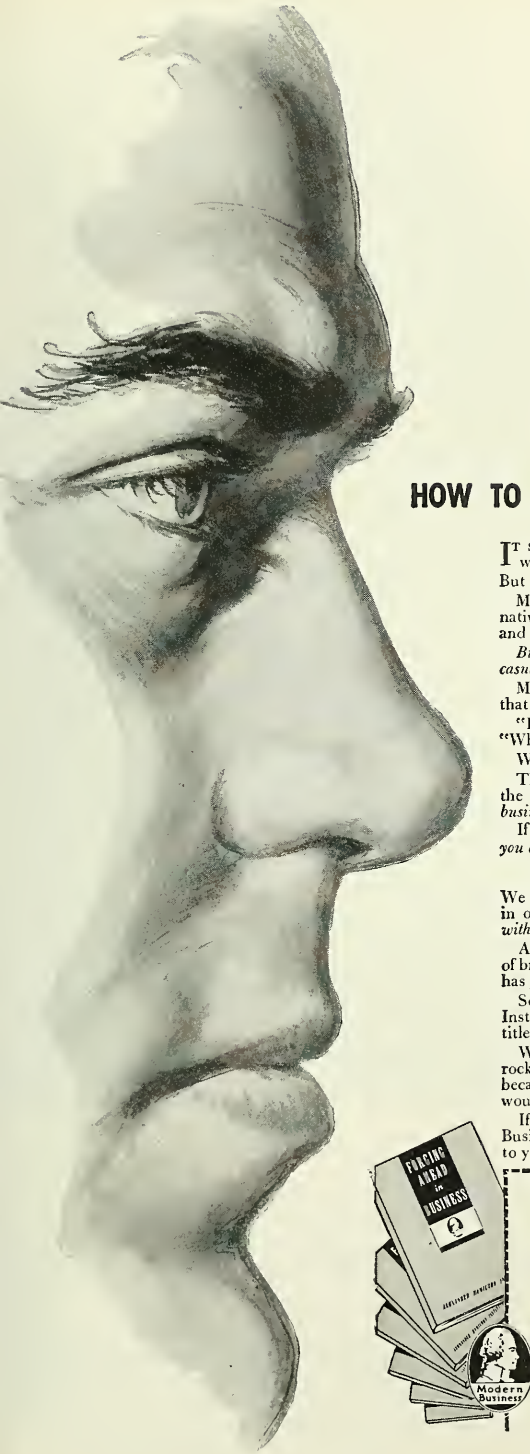

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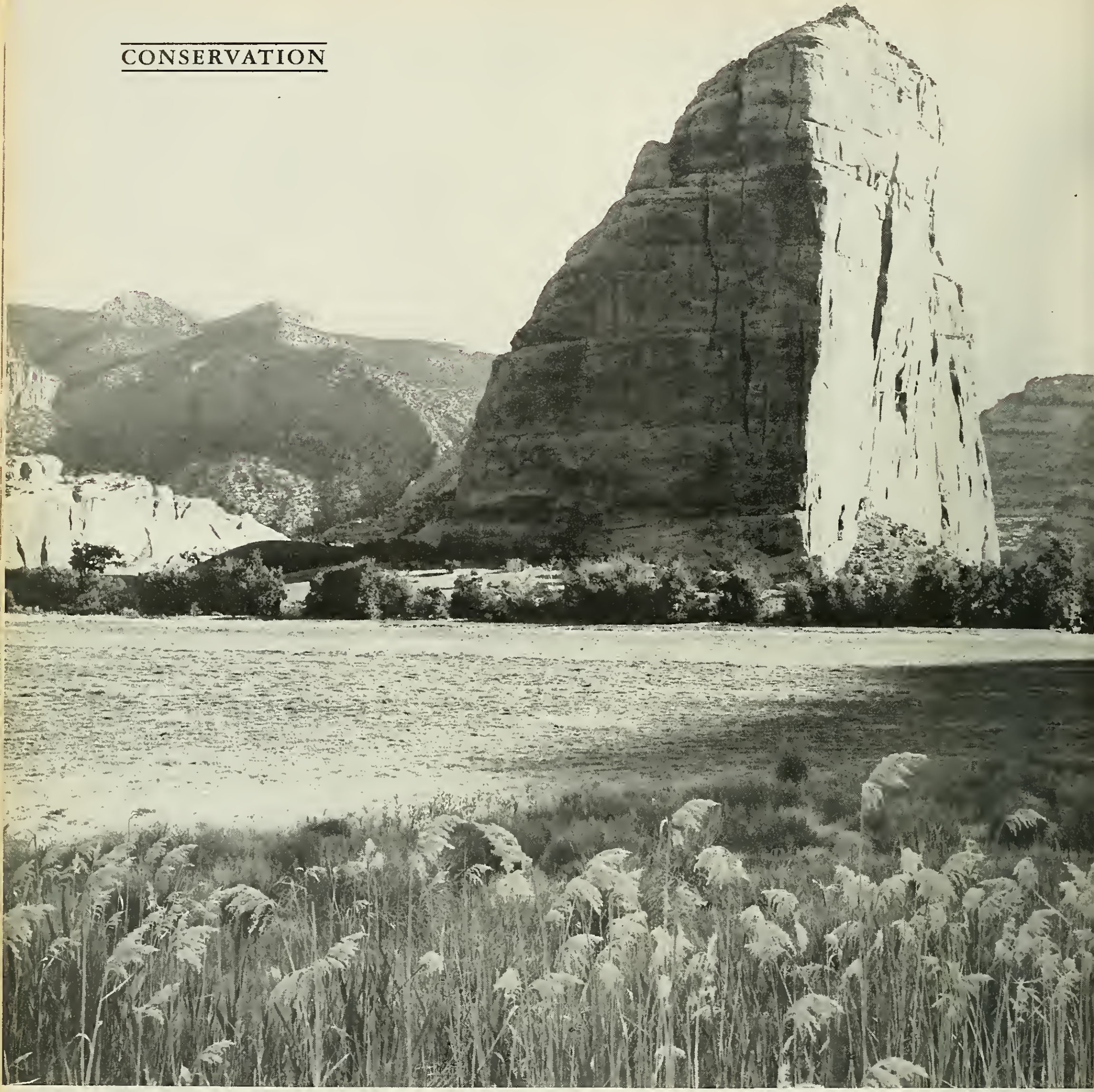

▲ Steamboat Rock, in Echo Park. Two thirds of the famous landmark would be submerged

One of the most crucial conservation issues ever to threaten the policies of our National Park system is soon to be decided in Congress

As Dinosaur Goes..

Photo by Philip Hyde

By Richard H. Pough
Chairman, Department of Conservation and General Ecology
American Museum of Natural History

In 1915, President Wilson set aside 80 acres in Utah as the Dinosaur National Monument. In 1938, this unit of our National Park system was enlarged with the primary purpose of preserving unimpaired the spectacular canyons of the Green and Yampa Rivers.

Status as a National Monument guaranteed this. Such areas are legally protected from disfiguring developments of all sorts. And in 1921 and 1935, Congress passed laws specifically safeguarding our National Parks and Monuments from invasion by water and power developments.

The Bureau of Reclamation, although knowing that existing laws prevented it, resolved to secure Congressional authorization to build Echo Park Dam within the boundaries of Dinosaur National Monument. According to the National Park Service, this dam would "irreparably" impair one of the most gorgeous natural wonders in America.

The present article must present chiefly the conservation arguments, but evidence has also been given against Echo Park Dam on economic and engineering grounds. In 1951, the Bureau of Reclamation asked the Army Engineer Corps to pass upon the practicality of the Upper Colorado River Storage Project, of which Echo Park Dam would be a part. The Army Engineers are known for their enthusiasm about building dams. Yet their Chief pronounced this project economically unsound.

Early last year, the fight to secure Congressional authorization for the dam sharpened. Able engineers on the side of conservation had urged the Bureau of Reclamation to consider certain alternative dams that would cost 10% less to build and store 6% more water.[*] The Bureau refused to accept the alternative sites, claiming that these sites would lose 350,000 acre-feet more water each year through evaporation.

On January 28, 1954, several errors in the arithmetic of the Bureau of Reclamation were pointed out in testimony offered by the Sierra Club. The Bureau's engineer admitted one mistake, remained silent about two others, denied a fourth, and glossed over a fifth.

On March 9, the Under Secretary of the Interior admitted a further error of 95,000 acre-feet in the rate of evaporation. On April 16, the Acting Assistant Reclamation Commissioner revealed an additional error of 45,000 acre-feet. In short, those who were trying to put the dam in Dinosaur National Monument were obliged to whittle down their argument against the alternative sites from 350,000 acre-feet in 1950 to about 25,000 by April 16, 1954.

On May 13, the Under Secretary of the Interior addressed a letter to a member of Congress admitting the last error. But five days later, this letter was prevented by parliamentary maneuvers from being read into the official record. Even so, it was by the narrowest possible margin that the House Interior and Insular Affairs Committee approved Echo Park Dam. The vote was 13 to 12.

The ideals under which the National Park System was created put the burden of proof squarely on those who want to invade Dinosaur National Monument. However, conservation-minded citizens have been forced to wage an expensive campaign to save what is guaranteed by law.

As the bill went before Congress, thousands of telegrams flashed across the country—destination Washington. Congressmen, senators, the Secretary of the Interior, and even the President were urged to preserve Dinosaur. Forces favoring the dam sought a loophole in the laws protecting the area in a provision that had been made to allow another dam in another part of the Monument. This was for the Brown Park Reservoir near the northern boundary, where a dam would have flooded only one mile of canyon. The Echo Park project would flood 100 miles of canyons and put more than 300 square miles under water.

---

[*] For additional arguments, see "Would You Dam Dinosaur National Monument?" by Richard H. Pough, in Natural History Magazine for March, 1954, p. 144.—Ed.

Conservationists are defending Dinosaur because they know that loss of this issue will expose other National Park areas to invasion by special interests. Seventeen other projected dams are now pending in eight National Parks and Monuments. Authorization of Echo Park Dam would be the go-ahead signal.

The bill authorizing construction of the Upper Colorado River Storage Project did not come to a vote in the last Senate. But advocates of the Bureau of Reclamation's project have now amassed a war chest and have carefully mapped their strategy. The showdown will come in the 84th Congress, now in session. A whirlwind offensive will be spearheaded by the Upper Colorado River Commission. This organization, which represents local interests in Colorado, Utah, Wyoming, and New Mexico, has raised $40,000 and hopes to collect $100,000 more for an intensive propaganda campaign.

The defenders of Dinosaur, too, have stepped up their forces. New in the field is the Executive Committee of the Council of Conservationists, which will co-ordinate the efforts of nearly 50 conservation and nature groups. Further, American conservation will for the first time have a legally registered lobby in Washington: The Trustees for Conservation. This body was recently formed to work directly for legislation to preserve, protect, and extend our National Parks and Monuments, Wildlife Refuges, and Wilderness Areas. Its Dinosaur National Monument Council will make the first advance along this line.

These will be the minutemen in the coming legislative battle. But the defenders of Dinosaur will need also the active, behind-the-lines participation of every public-spirited organization and individual in the country.

The opening guns in the battle for Dinosaur have been heard across the nation, but the outcome is in doubt. One thing is clear: it will be a war of conflicting principles. Shall we preserve our National Parks and Monuments as originally intended for the benefit of all, or shall we hand them over one by one to powerful special interests? The Colorado water storage project can be achieved without violating the Monument. Echo Park Dam would be the entering wedge. As one telegram of protest put it:

AS DINOSAUR GOES, SO GO THE OTHERS.

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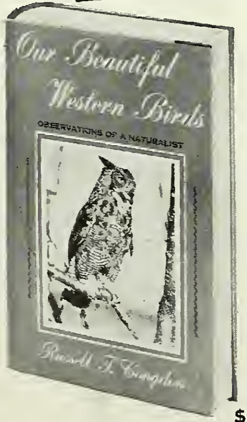

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Through Helen Martini's fond eyes we see, step by step, the raising of such animals as the affectionate and inquisitive deer, Dolly, a melancholy howling monkey, young orangutans, gorillas, a chimpanzee, and lovely Decca, the tigress that grew to maturity and in time brought her offspring to Helen for approval. Decca was one of the original three tiger cubs raised in the author's apartment that had to go when they went on a meat diet, the mistrustful landlady fearing that they might eat her next.

Largely in tribute to Helen Martini's success as a foster mother, a nursery has been established at the Bronx Zoo, where every year the lives of young and valuable animals are saved.

George G. Goodwin

STRAY FEATHERS FROM A BIRD MAN'S DESK

- - - - - - - - - by Austin L. Rand

Doubleday, $3.75
224 pp., 60 line drawings

DR. RAND, of the Chicago Natural History Museum, has also had a long association with the American Museum in New York. For years he has kept a file of the by-products of ornithological research, that is, items interesting in themselves but extraneous to whatever manuscript he had in preparation. Now he has collected these oddments in a book of 60 short, journalistic chapters. Their titles and substance indicate that a curator of birds hears the same yarns and is asked the same questions, regardless of the community in which he works.

A random half-dozen of his headings includes Birds Using Tools, Traveling Nests, Feathered Baby-Sitters, Hibernation in Birds, Bird Graveyards, and Survival of the Unfit. Although some absurd accounts have been published of sparrows nesting and rearing their young on transoceanic steamers, Dr. Rand has at least established that tree swallows nest on ferryboats plying more than a mile across the St. Lawrence River between New York and Ontario, and that barn swallows have nested in baggage cars on a two-mile portage between British Columbian lakes.

He tells an amusing anecdote about a shrewd Hudson's Bay Company fur trader who geared his credit policy to the abundance of snowy owls. This canny businessman recognized the ecological links between owls, Arctic foxes, and lemmings. Since both owls and foxes eat lemmings, many owls meant many lemmings: many lemmings meant many foxes, and many foxes meant the Eskimo trapper would have a good year and should be extended credit for supplies.

Among his other oddities are: the crocodile plover of the sun-burnt Nile valley, which buries both eggs and young in the sand and humidifies the site with water carried in its gullet (European storks practice a similar kind of "air-conditioning" at their nests); birds that rely upon incubators of rotting vegetation instead of body temperatures; others that prefer the company of monkeys to that of their own class; birds that carry out co-operative drives for food, and birds that quench the thirst of their young with

continued on page 109

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Snow Rangers fight avalanches with artillery, dynamite, and skis to protect half a million people who work and play in the alpine zones of the Wes

They Bust AVALANCHES Wide Open

By Howard E. Jackson

Seattle Post-Intelligencer photo

▲ Target: mountainside. Artillery Captain Stanley R. Mathews, Jr., directs gunfire with a battery commander's scope

◄ A big gun roars i
the battle of the ava
lanches. An army gur
ner from Ft. Lewis
Washington, pulls th
lanyard of a 155-mn
artillery piece an
sends a shell scream
ing toward a poter
tially dangerous are
A direct hit in a ser
sitive spot will brin
the avalanche dow
on man's timetable in
stead of a mountain

Bill Parke, USFS photo

▲ **Alluring but fickle Mt. Baker** (10,750 feet), in the Cascade Range of northern Washington, was the scene of one of the worst avalanche tragedies. Near its summit on a sunny day in July, a monster snowslide swept over a party of 25 climbers, killing six of them. Four bodies were never found

Howard E. Jackson photo

➤ **Technique No. 2** for busting an avalanche is blasting it with pre-set high explosives. There are no set rules, says a veteran Snow Ranger, except to use plenty of dynamite

"WHAT gives?" you wonder as you slow your car to a stop behind the stalled cars on the mountainous, snowlined highway.

You lean forward to set the handbrake.

BOOM!

You bolt upright, keenly alive as you hear the roar of cannon ahead. The eerie scream of a shell speeding through space sets your nerves tingling. There is a dull thud as the projectile hits the mountainside.

"What the heck . . ." you start to say as you roll down your window and anxiously search the snow-covered peaks.

BOOM!

The second blast sounds louder, nearer. The shell goes screaming into the distance. You hear it crrump into the mountain.

Puzzled, you impatiently await a state patrol car moving down the line toward you.

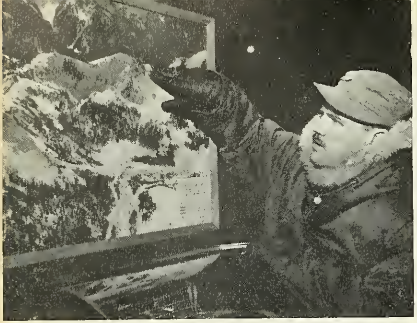
"What's up?" you yell as it draws near.

"Avalanche blasting with artillery," the officer shouts back. "Dangerous snow conditions threatened the highway. Those shells knocked a slide across the road. Snowplows will clear the way in a few minutes."

"Who puts on the show?" you ask.

"Snow Rangers!" the officer answers cryptically as the patrol car passes by.

You might have this unusual experience in the near future. It could happen to you on a main or secon-



Seattle Post-Intelligencer photo

▲ Commander of the artillery blasting detail. Major Tremaine Smith. points out the top of a ski lift where a 75-mm. artillery piece was hauled to blast snow cornices overhanging a skiing area

dary highway in the high Cascade Mountains of Washington or Oregon, in the rugged Rockies of Colorado or Utah, or in the snow-capped Sierras of California.

At one time the odds against a car and an avalanche arriving simultaneously at the same point were great. The odds have been getting smaller with increasing winter travel. But the Snow Rangers fought and won what amounted to a pitched battle—artillery versus avalanches—at Alta, Utah, during the winter of 1950-51, and, since then, more and more western states have become interested in the possibility of controlling snowslides by gunfire. Colorado has established its own highway avalanche protection service. Washington has built snowsheds to protect travelers, is now seriously experimenting with artillery fire for controlling avalanches.

Although the Swiss have lived with the avalanche for centuries, and have long since learned how to release dangerous snowslides by artillery fire, avalanche research is new in this country. It had its feeble beginning in 1937-38 when Forest Ranger C. D. Wadsworth was detailed to Alta in the Wasatch Mountains of Utah as a full-time snow and avalanche observer. But our avalanche control program grew slowly. It grew strong only with the coming of the Snow Rangers.

Snow Rangers may seem like a new occupational group, but in reality they are U. S. Forest Rangers on winter duty. In summer you see them in our National Forests doing administrative work, making timber surveys, riding sheep and cattle ranges, and perhaps fighting forest fires. During the winter you probably remember them the way you saw them last, in an unchanged environment. It is perhaps surprising to learn that their winter duty is quite different. It is often cold and dangerous, and at times touched with tragedy.

Their chief concern is the safety of skiers using winter sports areas in our National Forests. When an accident happens they feel personally responsible. And accidents do happen . . . like what happened to Keith Jacobsen, only child of Berne Jacobsen, city editor of the Seattle *Post Intelligencer.* Three 17-year-old boys—Keith, Larry Schinke, and Edward Almquist—were on an overnight ski tour to Source Lake. Shortly after noon, five miles north of Snoqualmie Pass, a slide rumbled down the slope and engulfed Keith and Larry. Edward escaped. It was three o'clock by the time he made his way back to the Pass.

Ross Files was the Snow Ranger on duty. He immediately dispatched two rescue parties, but the going was rough and the weather foul. Many volunteers had to turn back. Despite shortages of men and supplies, and then darkness and biting cold, he and the remain-

▼ After it was all over. This distant view shows the terminus of the fatal Mt. Baker avalanche. Rescuers appear as black specks in the center of the picture

➤ Close-up view shows where a college student's body was found. Of the six persons killed, only two bodies were recovered. Others were believed lost in crevasses

Bill Parke, USFS photos

ing helpers found Larry shortly after 9:30 that night. Larry had recovered consciousness after being hit, to find himself buried under three feet of snow. His arm made a small air pocket which allowed him to breathe. Although trapped for nine hours, he suffered only mildly from exposure.

The search went on until midnight when a storm made further probing and calling impossible.

"It was a rough night," Ross relates. "We had but half a dozen sleeping bags among the score of volunteers. The men grabbed what rest they could by taking turns."

At sunrise the search began again. Keith was found at eight o'clock—dead from a broken neck caused when he struck a rock.

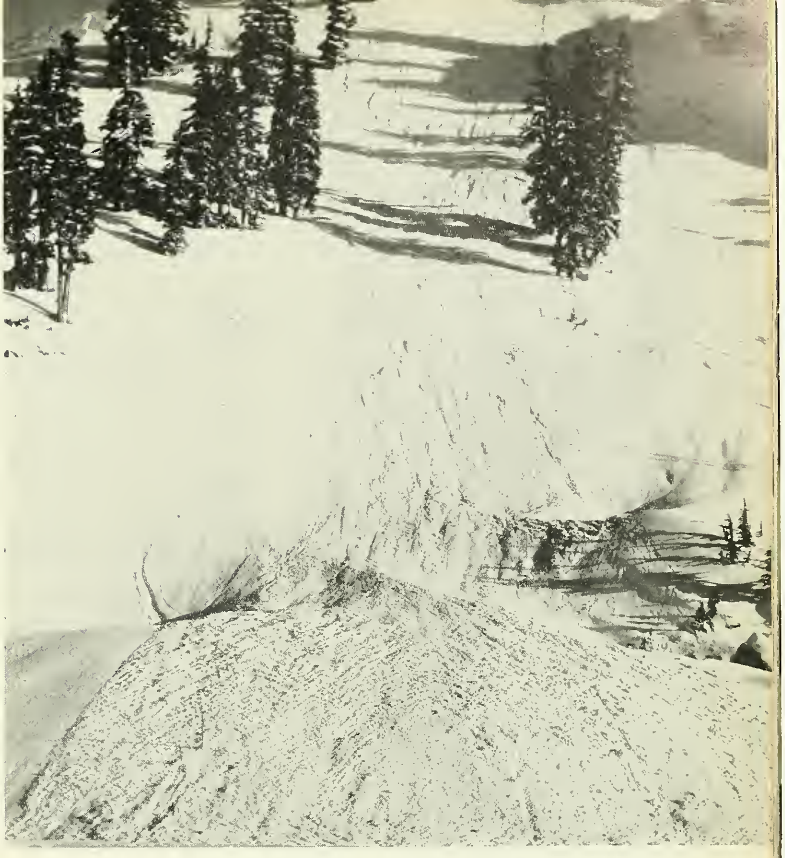
His death was especially tragic because it could have been prevented. The boys were not experienced mountaineers. They violated the rules of good ski-touring technique. They did not inquire about snow conditions from the local Snow Ranger, and they made the fatal mistake of exposing more than one member at a time to a dangerous slide area. No doubt the area looked safe, but any slope of more than 20 degrees can avalanche.

"Skiers forget that they are dealing with a great natural force, comparable to a flood, earthquake or tornado," points out Ross Files. "Of them all the avalanche is the most complex, and the dividing line between danger and safety is the most obscure. It is both powerful and deceptive."

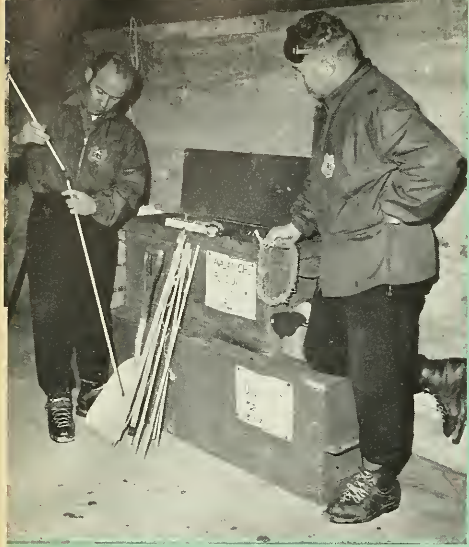
Novices are not the only ones fooled by an innocent-looking slope of snow. Recently (April 1954), no less a veteran than William Degenhardt was caught by an unexpected slide. Degenhardt is president of Seattle's famed Mountaineers, and has been climbing and skiing for more than 30 years. He, his wife, and a Mrs. Loretta Slater were working up a hogback which he thought perfectly safe. The snow had softened to a depth of four inches, and the slope was not steep. Despite this, an avalanche ripped loose. Degenhardt managed to stay on top but suffered hip and internal injuries when he struck rocks

Bill Porke, USFS photos

◂ MONTY ATWATER, No. 1 "Avalanche Buster" and father of the Snow Rangers. He claims his respect for snowslides is prenatal



▴ PORTRAIT OF A DEAD AVALANCHE. This innocent-looking pattern, resembling a much-used ski slope, is the trail of a fairly small avalanche. Note the "fracture point" (where it started) at the top of the picture. Ski tracks alongside give size comparison



▲ **John Herbert** (left), a Forest Service official, fastens together sections of aluminum tubing used for probes in avalanche rescue work. Monty Atwater holds a red safety cord used by "trigger man" when skiing down an avalanche

➤ **Out on ski tour**, Atwater (left) and Herbert check avalanche hazards at a popular winter sports area

Howard E. Jackson photos

▼ **At avalanche school**, Snow Rangers learn first aid for common slide accidents. Even a little slide can break a leg

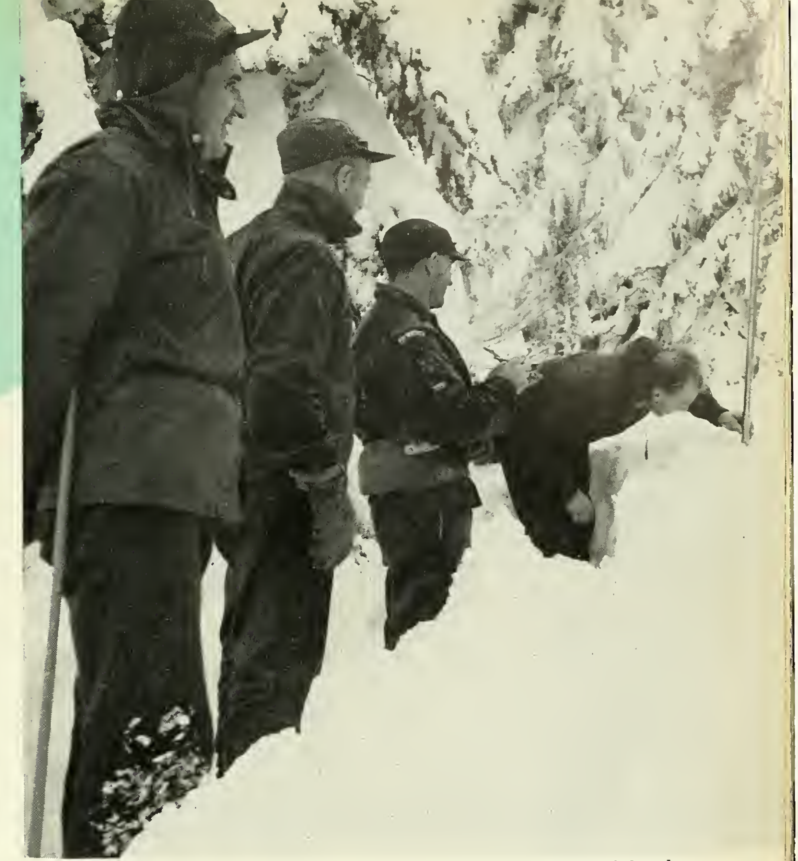
as he plunged over a 20-foot drop. The women were not in the slidepath. Rescue operations were relatively simple. Degenhardt was embarrassed.

"I felt like a blankety-blank fool for getting myself in a spot like that," he said with a grin from his hospital bed.

Although the avalanche busters' chief concern is for the skier, they also feel responsible for the safety of pleasure-bound mountain climbers, highway maintenance men, telephone and pipe line crews, and loggers who use or work near public land.

Accidents happen to them too. Headlines tell the stories: "Highway Workers Buried in Pickup; One Dead." "Sno-Go Crewman Smothered by Snowslide." "Watchman at West Tunnel Entrance Killed by Avalanche." "Ski Tow Operator Swept to His Doom."

➤ A PENETROMETER TEST is made by Snow Ranger Frank Foto. "Hammer" (rod within a tube) is dropped to determine resistance in various layers of snow and consistency of snow pack, useful information for predicting avalanches



Howard E. Jackson photo

One of the strangest of these accidents happened not in winter but in summer, on a July 22nd. Bill Parke, who directed rescue work, tells the story: "A party of 25 Western Washington College students and faculty were making an annual climb up Mt. Baker. They were on Deming Glacier, about to go over what is known as the Roman Wall, a steep promontory a few hundred feet from the top, when a snow avalanche started and caught every member of the party."

The climbers suddenly found themselves standing on a moving carpet of snow. "Dig in!" shouted the guides. When the group frantically sank their alpenstocks and ice axes into the firm snow underneath, the force of the slide bent them over like blades of grass and quickly swept the climbers off their feet. After that it was every person for himself as the snowslide tumbled them about. Many of them dropped into deep crevasses.

This out-of-season accident claimed six lives. Only two bodies were recovered.

Today, as more people visit the western mountains, the number of accidents is increasing. During the past two seasons we have had confirmed avalanche fatalities in Utah, Idaho, Colorado, California, and Washington.

The Forest Service inherited the avalanche hazard problem because most of the desirable alpine skiing terrain is on National Forest land. This land includes 90 per cent of the country's slide areas—notorious graveyards for avalanche victims—but ideal areas for recreation development.

The Forest Service is not content with the old-time answer to the avalanche hazard (either stay out of the mountains or take your chances), and in the interest of public safety has launched itself into the business of combatting avalanches.

Home base is Alta, Utah. During the heyday of the Gold Rush, Alta was destroyed repeatedly—but temporarily—by avalanches which brought death to the miners and destruction to their camps. It was obliterated finally by snowslides in 1874, with a loss of 60 lives. It seems fitting that it should be reborn as a winter ski area and be the site of the first observation and research center in the Western Hemisphere. Other main stations are at Berthoud Pass, near Denver, Colorado, and Stevens Pass in the Cascade Mountains of Washington.

Snow Rangers are stationed at these and other areas in the western states. The "White Death" has played a grimly historic role near all these areas. The greatest ava-

Howard E. Jackson photos

◄ REALISTIC EXERCISES call for simulated avalanche rescue work. "Victim" is located with aluminum probes; evergreen branches are used to mark his position; shovelers dig him out

▼ "VICTIM is carried on a stretcher to first aid toboggan...

lanche disaster in our nation's history took place just below the Stevens Pass station. It happened at Wellington, Washington, in March, 1910. Three trains were snowbound on parallel tracks. A single snowslide swept them off the little plateau and into the canyon; 118 people were killed and more than a million dollars' worth of rolling stock was destroyed.

Snow Rangers were the idea of Monty Atwater – America's No. 1 "Avalanche Buster," who claims his interest in avalanches is prenatal. Two years before he was born his father was buried in a slide that killed 50 men in a mining camp at Telluride, Colorado.

"That avalanche was what we call a double-killer," he explains. "It hit the bunkhouse, and when everybody rushed in to help, a second slide struck and did most of the killing."

Monty's father was rescued alive. The man who had been standing next to him was not found for six months.

Monty was born in a mining camp in Oregon. He himself had his first brush with an avalanche before he was one year old. "A snowslide came in the back door and filled up the kitchen while my mother fled with me in her arms to the front of the house."

He became personally interested in avalanches—simply as a matter of self-preservation—after he graduated from Harvard and became a game protector in the Glacier Park country. He saw deer, elk, mountain goats, and other animals caught in slides while foraging on steep open hillsides. He witnessed first-hand how railroads could be crumbled by snowslides. What impressed him most was the experience of a fellow worker. Monty tells the story as gospel truth:

"The man was held fast beneath the slide by his snowshoes for 24 hours. Finally he worked a hand free, got out his knife, opened it, cut the snowshoe bindings and dug his way out. Since he had no snowshoes, he had to swim ten miles down an icy river to get home."

During World War II Monty served his country in mountain and winter warfare. Afterward he returned to his old job in Montana, and again became interested in avalanches. When an avalanche guard job opened up at Alta he took it. There he championed the newly organized avalanche program, and in a few years fathered the Snow Rangers.

These bold mountain men are a triple-threat to potential snow slides. Busting an avalanche by means of bombardment is only one of their three commando-like tricks. Its chief advantage over the other two methods is that an entire area can be shot out easily and quickly from one location—even during a storm.

Firing projectiles into avalanche paths has disadvantages, though. The conventional 75-mm. or 105-mm. artillery piece is cumbersome in snow-covered terrain, and shells cannot be directed at targets close to fixed installations like chair lifts, rope tows and shelters. But the advantages will far outweigh the disadvantages when the lighter, more mobile, recoilless 75-mm. rifles become available.

Fighting avalanches with dynamite is the second technique. It is somewhat more dangerous than supervised shellings, which generally are made with the aid of army or state guard units. With this technique the avalanche is triggered by charges of military demolition, tetrytol, C-3 or TNT blocks. The charges are placed in shot holes or tossed out so that the operator can work from a protected position. This is a tailor-made operation, since slopes vary and many slidepaths have more than one release point, all of which must be tested. Cornices offer special problems, tricky problems that can cost a life if not worked out correctly. Often the rangers resort to pre-planted charges where cornices collect year after year and are an annual source of hazard.

"There is no set technique," Monty says. "The only hard and fast rule is to use plenty of dynamite!"

Blasters often get belly laughs as well as a bang out of their work.

"Folks like to go with us, and we take them," Monty relates with a grin. "Those of us on one trip will never forget the girl from Chicago. We crossed a slide area and decided to knock it down. We told her to turn her back to the explosion so that the shock wave wouldn't hurt her. She turned, and squatted. When the wave hit her, it knocked her flat on her face, in a most awkward and undignified position."

. . . and transported down the mountain to a waiting pick-up truck

Later, the party clung to a group of trees while a charge was set off uphill from them. More snow avalanched than expected. When the snow mass hit her, the girl lost her grip, but one of the men grabbed her. She clung tightly to his arm as the snow went swooshing under her.

"Imagine taking a snowride facing uphill, with the snow going under you!" she laughed when it was all over.

Snow Rangers "On Loan"

Monty had a ridiculous experience too, but with a different denouement. Forest Service personnel are often "loaned out" to railroads, power and light companies, and other public and private organizations. Monty and Ralph Wiese, Snow Ranger from Mt. Hood, Oregon, were on special assignment to the American Telephone and Telegraph Company. Its transcontinental transmission towers near Donner Pass were threatened by avalanches. Crews could not get into the snow-blocked area and it was costing AT&T $1000 a day for the men. A general shut-down of the system would cost hundreds of thousands of dollars. Monty and Ralph were to "delouse" the avalanche paths so the crews could get back to the lines.

Only one local skier was available. Not much blasting wire could be carried. When the men came to the last of four slidepaths there was not enough wire to stretch from the charge at the fracture point to a protective position over a ridge.

"I had no choice but to duck behind a tree, downhill to the charge I was to set off," Monty relates with a chuckle. "Ralph belayed me with a safety rope fastened to my belt. He and his helper were out of sight behind the ridge when the blast went off. The slide rolled down the slope and raced through the trees so fast the snow was boiling up around my legs before I knew it. I started to climb that tree but the rope tightened. The harder I climbed the tighter it got. I didn't know it then, but when Ralph felt the tension on the rope he thought I had been swept into the slide. He held on for dear life. Meanwhile I was trying to claw up that tree like a cougar with a pack of hounds on his tail. When the slide finally stopped I was buried up to my armpits."

"Skiing down" an avalanche is the last of the three stratagems employed by the Snow Rangers. It is by far the most dangerous; takes skill and good judgment, and can be troublesome even for an expert.

Two men work together. They climb, via a safe route, to the top of the slide area. One man keeps watch. The other makes a ski run across the face of the prospective slide, cutting it inches above the fracture point. Beforehand, this "trigger man" generally loosens his ski bindings, removes his ankle straps and unfastens his ski pole slings from his hands. In case he is caught in a slide he can quickly shake off these encumbrances and save himself by "swimming" on top of the snow mass. He also trails a long red parachute cord behind him. His partners—he hopes—will find him by following the cord if he does get buried in the snow slide.

His weight, and the shearing effect of his skis, crack open the snow with a loud snap. As he races for safety the avalanche breaks loose and crashes down the hillside—piling up at the bottom to a depth of 50 to 100 feet.

"Personally I prefer planting explosives to using my hickory staves to create an avalanche," Ralph Wiese frankly admits. "Every time I ski down an avalanche I get the flutters in the pit of my stomach."

Despite the danger, no Snow Ranger has taken a fatal ride in a self-made avalanche. A number have been caught. Some have been buried. Generally they get tripped

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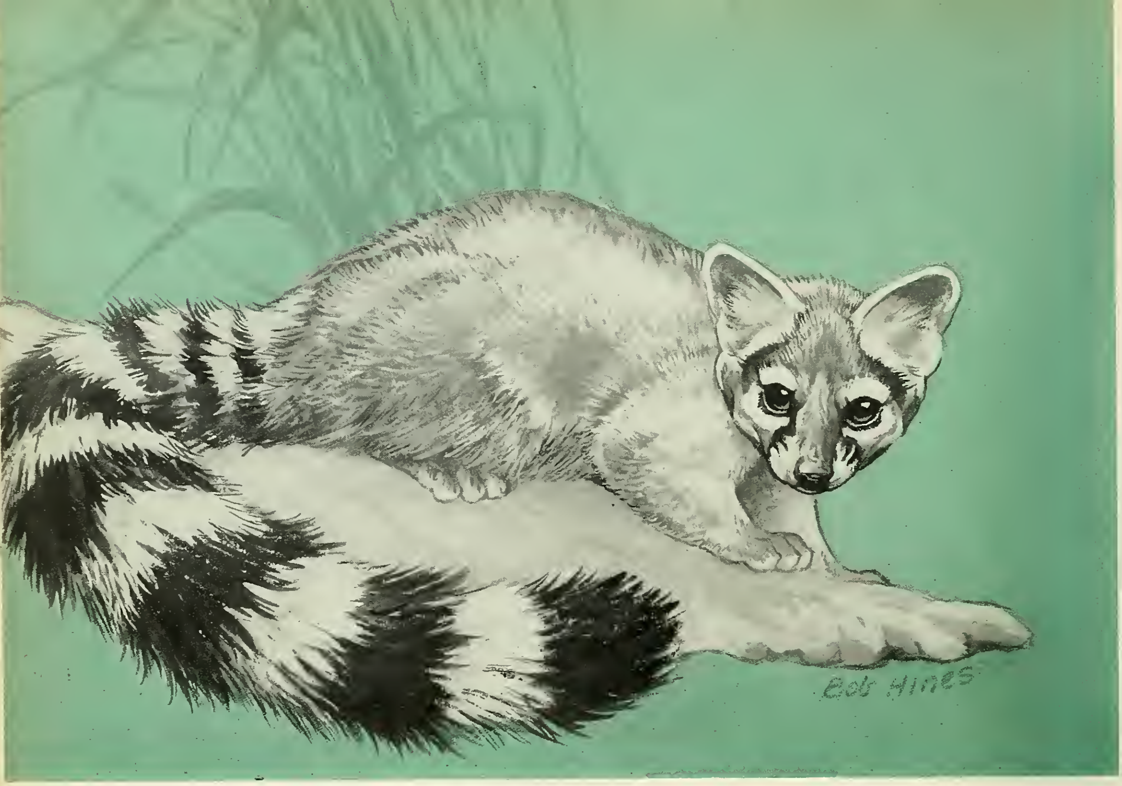
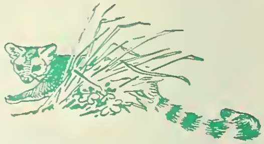


▲ **Cacomixtle** is what the Aztecs called this large-eyed little tree climber. The ringtail is found in southern United States west of Texas

Ringtailed "WHATZIT"



The night-prowling ringtail is confusing because it resembles "everybody and nobody." It has been likened to the cat, squirrel, fox, and marten, but is most closely related to the North American raccoon

By Will Barker
Illustrations by Bob Hines

THE ringtail, one of the nation's picturesque mammals, has a scientific name that is a jawbreaker. It is *Bassariscus astutus,* which means "clever little fox. And though the ringtail has a head shaped somewhat like that of a fox, he does not belong to the fox family at all. He is a distant cousin of the raccoons of North America, but not nearly so widespread.

A small and slender catlike animal, with a very long bushy tail, the ringtail lives exclusively in parts of the West and the Southwest, where he is known by a number of names. Some of these are coon cat, band-tailed cat (perhaps because of the seven whitish rings on his tail), raccoon fox, mountain cat, and cat-squirrel. One of the more unusual names is *Cacomixtle,* an Aztec word that is spelled "cacomistle" north of the Border. Sometimes the ringtail is known as the miner's cat because the little animal is a mobile mousetrap that keeps a prospector's cabin free of mice. Rodents, including wood rats, chipmunks, and ground squirrels, are not the only meat he eats. The little creature likes insects, centipedes, and birds such as towhees, thrushes, and sparrows, as well as fruits of many kinds. When the dates are ripening in the orchards of Lower California, where he is known as *babisuri,* the ringtail prowls around under the palms at night with gray foxes and spotted skunks, picking up fruit that has fallen to the ground.

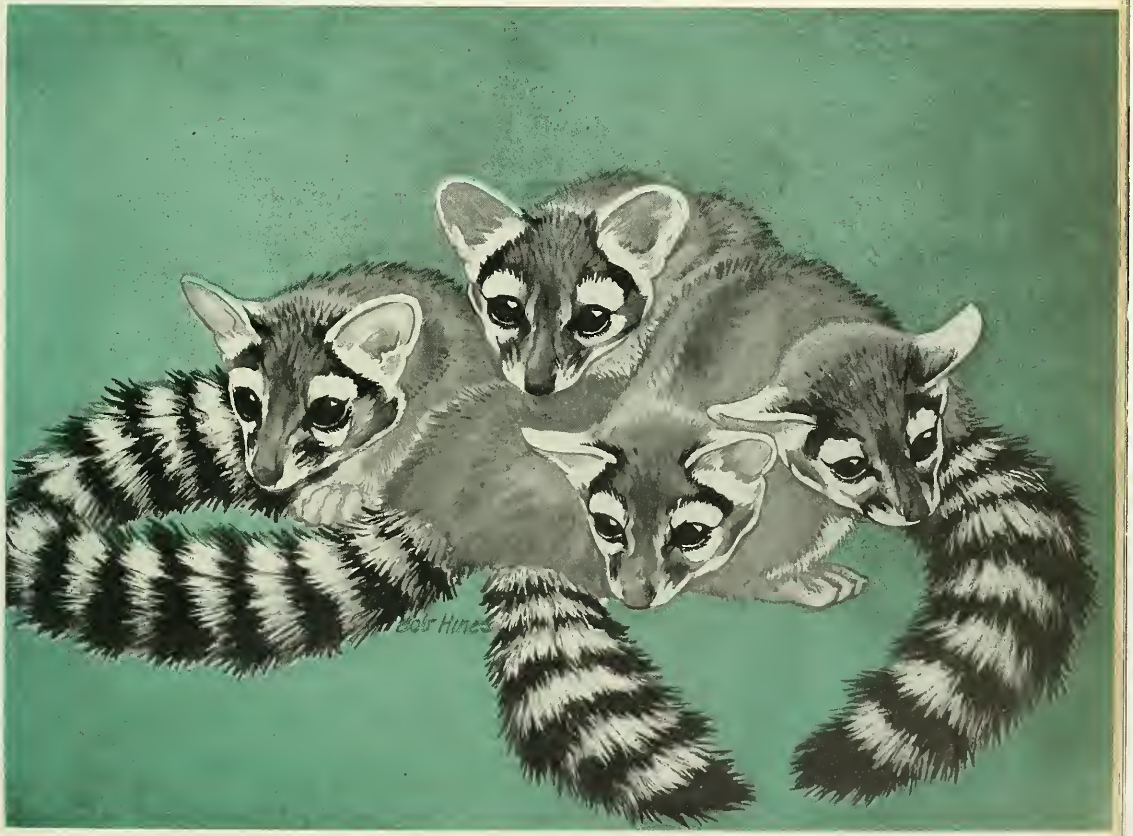
Like most animals with big eyes, the ringtail is abroad mainly at night, though, as if sensing the benefits of ultraviolet rays, he does come out at noonday to sleep in the top of a tall tree.

His luxuriantly bushy tail measures at least one-half of his total length of 25 to 30 inches, and he hunts with it arched over his back—a habit that might fool some predators, including the great horned owl, into thinking that he is too big to handle. Another enemy of the ringtail is the rattlesnake, which crawls into rocky crevices after the young.

If you are lucky enough to catch a young ringtail, you will find that he makes a delightful pet. He is gentle and intelligent, and prone to get into amusing scrapes because of his endless curiosity.

In addition to living among rocks, the ringtail also makes its home in hollow trees. Both types of habitation are always near water, as the ringtail is a great drinker. During May or in early June, three to four young are born, about the size of newborn kittens. They have blunt noses and are blind and toothless. Their skin is pink and covered by a scant, whitish fuzz. Their stubby tails give no hint of the size to which they will grow, but they do show a faint forecast of the black rings that will ultimately be so conspicuous. At about four months, the young ringtails are weaned and leave home.

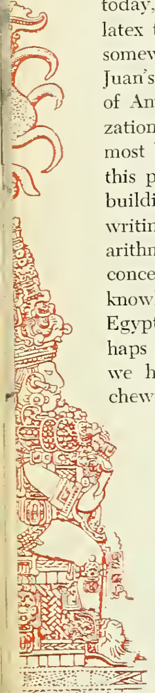
▼ **QUARTET OF YOUNG RINGTAILS** makes a pleasing family group for the artist's palette. The young, born in May or June, are about the size of newborn kittens, and are able to fend for themselves in about four months



The Chewing Gum Tree

In the land of the ancient Mayas grows the versatile sapodilla tree, a forest giant that fostered a distinctively American exercise

By Henricks Hodge



NEXT time you pop a stick of gum into your mouth, consider Juan Cocom, a Maya Indian of today, who may have coaxed the latex that went into it from a tree somewhere in the Yucatán jungle. Juan's ancient forebears created one of America's most advanced civilizations and have been called "the most brilliant aboriginal people on this planet." They fashioned noble buildings, invented New World writing, developed a wonderful arithmetical system involving the concept of zero, and in astronomical knowledge surpassed the ancient Egyptians and Babylonians. Yet perhaps the most conspicuous thing we have borrowed from them is chewing gum.

The discovery of the chewing gum tree, or *ya* as the Mayas called it, was really not such a feat, considering its abundance.[*] The chewing gum tree is the commonest tree on the limestone plains of Mexican Yucatán, from Cape Catoche to Lake Peten in the northeast corner of Guatemala. Under favorable conditions, it is one of the tallest trees in the jungle. Individual specimens may reach a height of over a hundred feet and a diameter of three or four feet. Some of them may have looked down a thousand years ago upon the daily doings in the old Maya cities whose ruins now dot the area. Many giants among them were felled by Maya workers with primitive stone axes to serve as timber in their classic stone buildings, and smaller ones served in the thatched huts of the common folk. Some 25 years ago, over a hundred million chewing gum trees probably existed in Yucatán alone.

Our civilization calls the tree chicle, and its scientific name is *Achras zapota.* It is also called the sapodilla, and the delicious fruit bears the same name. The aborigines must have early recognized its merits. It is rough-skinned and about the size of an apple. Several

AMNH

▲ A SOURCE OF FUN FOR KIDS and exasperation for parents is the most famous product of the sapodilla tree—chicle, or chewing gum latex. Other forms of latex are used in rubber and for insulating materials long black seeds are found at the core. The sweetish brown flesh of the sapodilla fruit is highly distinctive in flavor. "Small, very sweet, and delicious to eat," wrote Fray Diego de Landa, second bishop of Yucatán, in 1566. He admitted that some sapodillas are much better than others and suggested that the best quality would be highly prized in Spain. Others have agreed with him, for sapodillas have long since been introduced as an unusual fruit throughout the tropics and subtropics of the world. The tree can be grown in frost-free parts of Florida, and has found the Florida Keys so much to its liking that it has become naturalized there.

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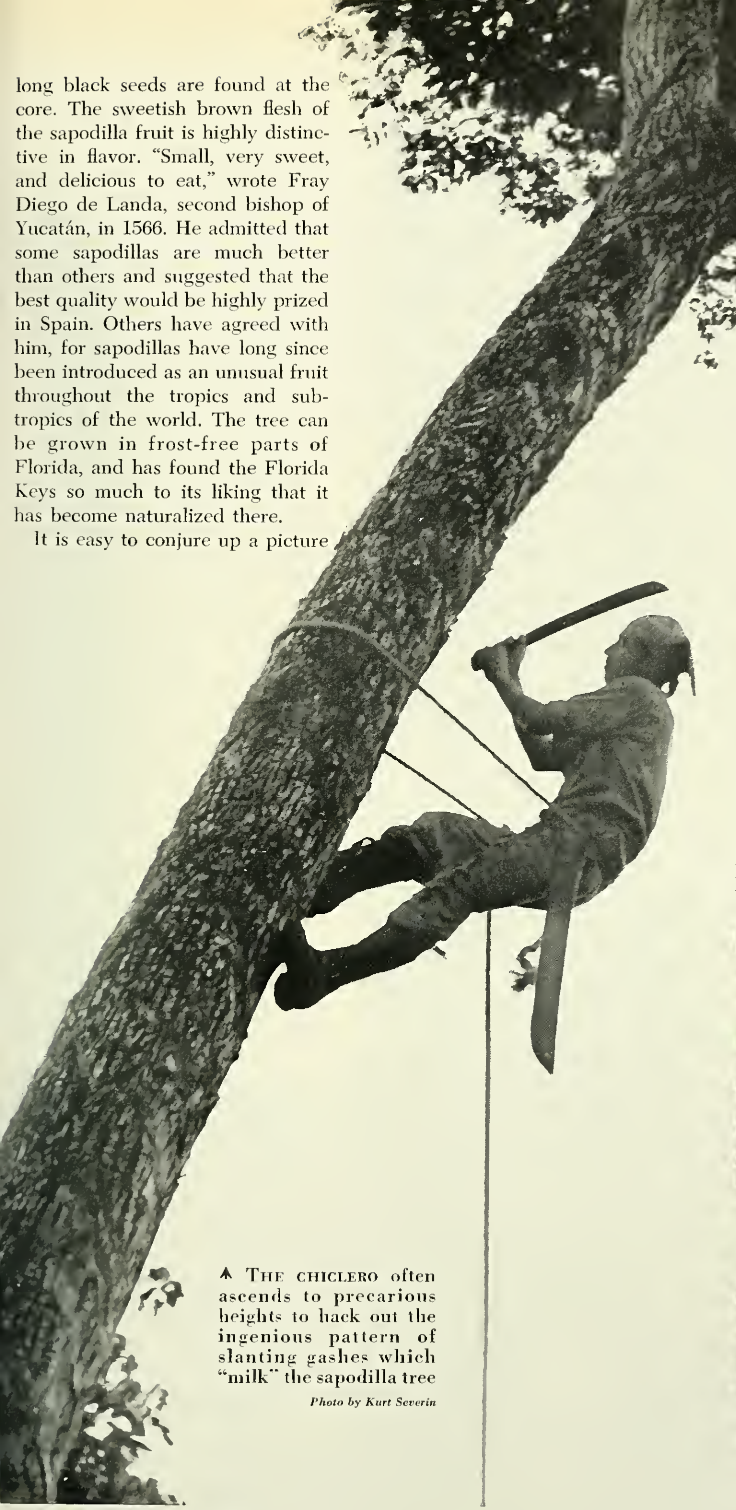
[*] "Chicle or *tsicte* (from the Nahuatl, *tsictli*) was well known to the ancient Mayas, being chewed to quench thirst, and also as an accompaniment of meals. . . . [In the Motul Dictionary] the latex is called *itz;* when boiled and ready to chew, *cha.*" (Paul C. Standley, *Flora of Yucatán,* Field Museum of Natural History Publication 279, Botanical Series, Vol. III, No. 3, 1930.)

It is easy to conjure up a picture

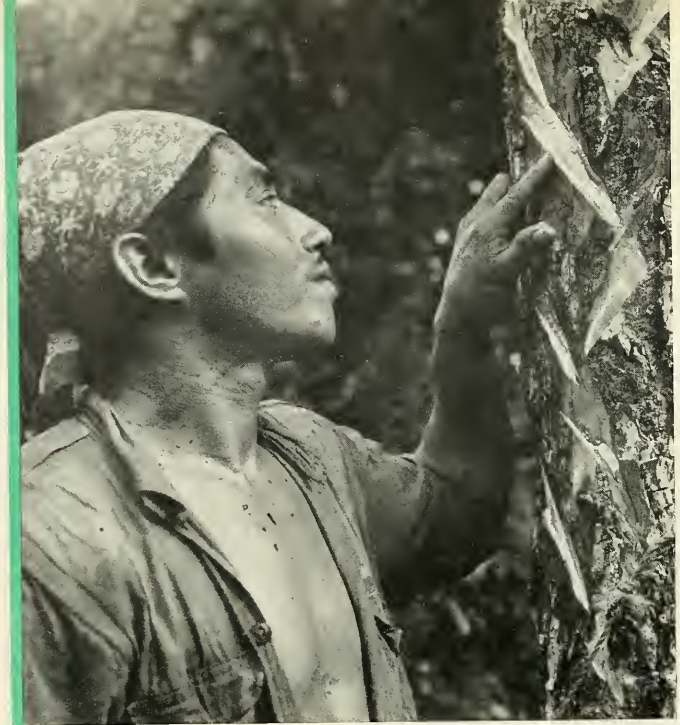


▲ THE CHICLERO often ascends to precarious heights to hack out the ingenious pattern of slanting gashes which "milk" the sapodilla tree

Photo by Kurt Severin

▼ LAUREL-LIKE FOLIAGE and delicately flavored fruit make the sapodilla tree a favorite for tropical gardens

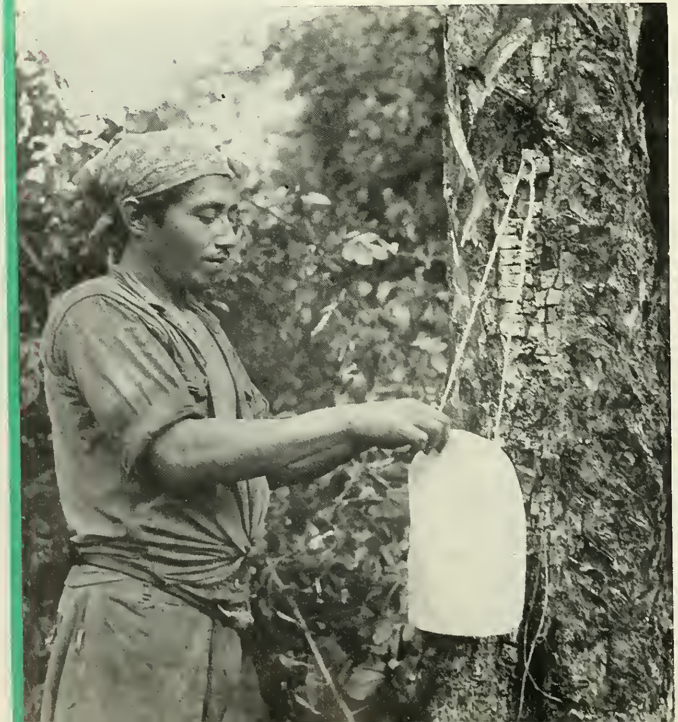
Photo by Henricks Hodge



Photos by Kurt Severin

▲ Smooth, milky-white latex exudes from the injured bark and progresses down a zigzag path...

▼...to a small canvas bag at the base of the trunk. Eight to 24 hours after tapping, the small bags are emptied into a larger one, which is...



of a pre-Maya hunter unintentionally injuring a *ya* tree while collecting its fruit. The thick creamy latex exudes from the wound, and he is surprised. As it is exposed to the air, the stuff thickens into a gummy mass, and he works it between his fingers.

Time to find use for the gum was to be measured in centuries, so it is no wonder that the Mayas learned to chew it. As though to forecast the modern stick of gum, though on a larger scale, they rolled the stuff into thick sticks and wrapped them in the leaves of the wild banana plant.

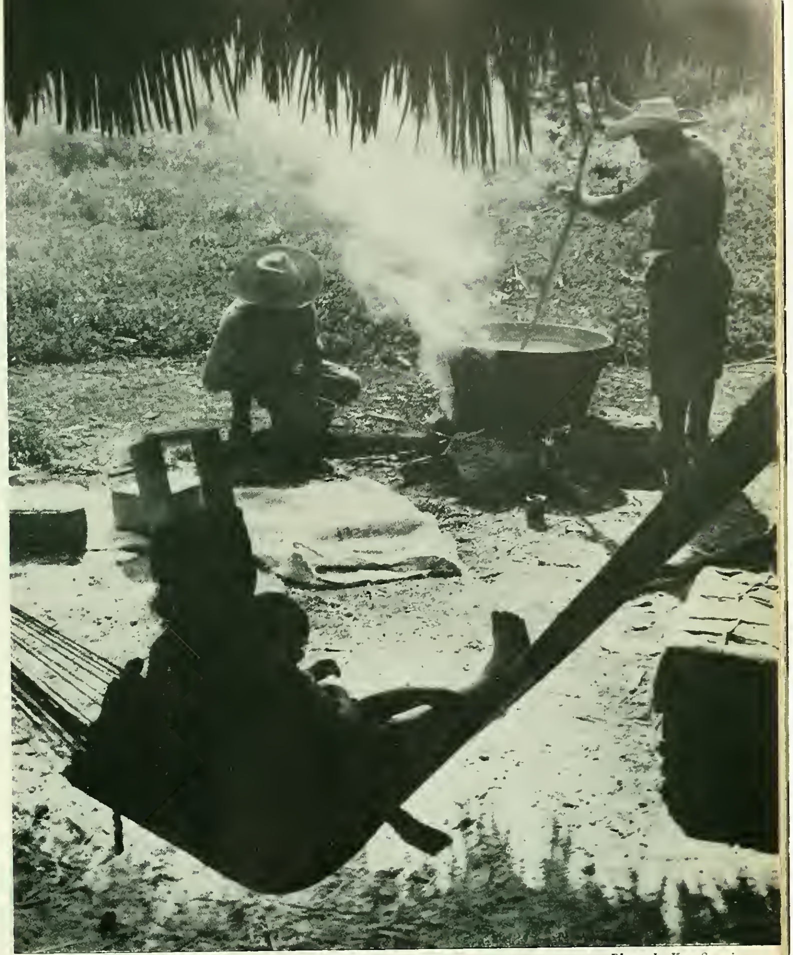
Wood like mahogany

Sapodilla wood, like certain mahoganies, is red in color, fine-grained and hard. It surpasses mahogany in its durability. Apparently because of this, it was selected by the Mayas above most other domestic timber trees for construction. Many lintels, of zapote, as it is called, have survived in ancient Maya doorways to the present day. Some of them are intricately carved, the finest being those in the great pyramid temples of Tikal near Lake Petén-Itzá. But even the more frequently visited ruins of Chichén Itzá have their share of fine lintels.

The dense, well-proportioned crown of the sapodilla is so handsome that it has become a favorite in gardens throughout Central America. It is enjoyed not only for its fruit but also as a fine shade tree and because of its evergreen laurel-like leaves. The Maya agriculturists seem to have learned that when the sapodilla is planted outside its native forest, it branches freely and produces far more fruit than under wild conditions, for the trees are especially common around the ruins of ancient settlements. But planted trees are not as good a source of latex, for their production decreases under cultivation. The tree bears inconspicuous little white flowers.

Juan Cocom, like all *chicleros* (chicle gatherers), looks forward to the wet season, for that is the time of increased flow. "Without rain, there is no chicle," is the saying down in Yucatán, and June marks the beginning of the six- to seven-month rainy season. Juan has probably seen no cold cash since the previous chicle harvest. Between seasons, he practices the simple farming of his ancestors, clearing small patches in the forest to grow corn. From this, his wife makes the staple pancake-like tortillas that represent the family's daily bread. A chiclero's life is a hard one. though perhaps less so while he is living in his permanent home, existing as a subsistence farmer. Living becomes more primitive when the rains arrive, for then he moves to a more primitive shelter in the forest, daily to seek out the chicle. Against the drenching rain, he builds a simple hut with a thatched roof and slings hammocks in it to provide sleeping accommodations for the whole family. Eating is also simple, and monotonous. His wife's tortillas, red beans, and coffee must do for three meals a day, week in and week out.

Perhaps the chiclero's greatest problem is to get food for his mules. Without mules, the crude chicle could not be transported. Subsistence for the mules in the form of green pasturage is all but lacking in the forest, so Juan finds breadnut trees and cuts their branches off to make the leaves available as browse for his animals. The tropical rains bring higher humidity, skin diseas-

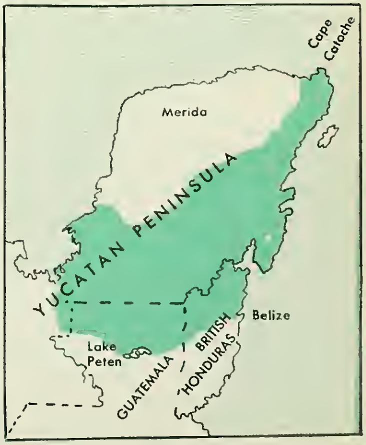


Photos by Kurt Severin

▲ ...on week ends. whole families of chicleros take turns at tending the great cauldrons of latex. The gradually thickening mixture is boiled and stirred constantly (to prevent scorching) for three to six hours

▼ ... transported over rough jungle trails to a camp for boiling. There...

▼ Sapodilla trees are dispersed widely over forested plains of the Yucatán peninsula. Range is indicated by solid color



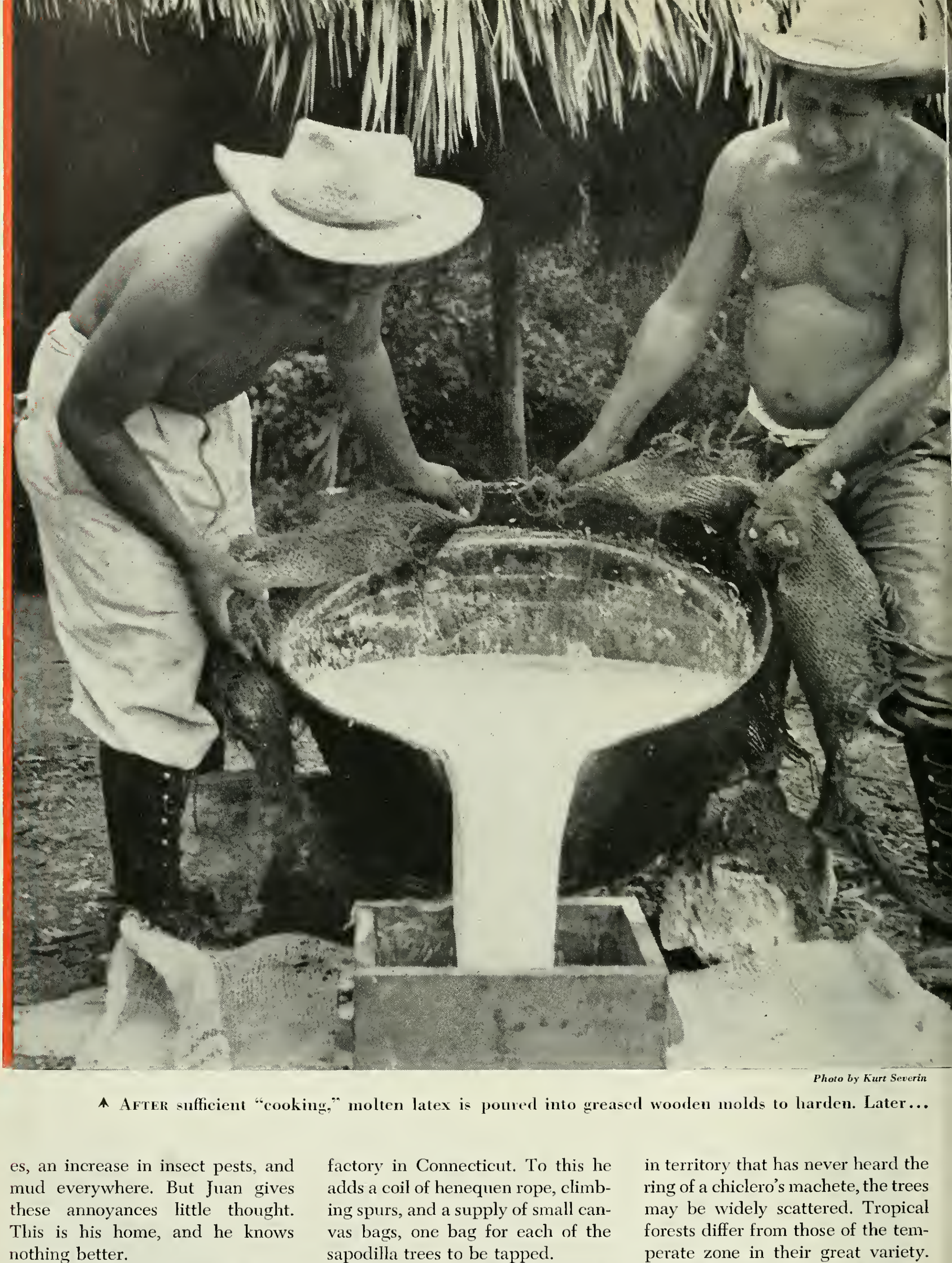


Photo by Kurt Severin

▲ AFTER sufficient "cooking," molten latex is poured into greased wooden molds to harden. Later...

es, an increase in insect pests, and mud everywhere. But Juan gives these annoyances little thought. This is his home, and he knows nothing better.

The most important thing in Juan's professional equipment is his machete, the long jungle knife, which as likely as not came from a factory in Connecticut. To this he adds a coil of henequen rope, climbing spurs, and a supply of small canvas bags, one bag for each of the sapodilla trees to be tapped.

His first task is to locate the trees. This may be easy or difficult depending upon whether he is working in virgin bush or not. But even in territory that has never heard the ring of a chiclero's machete, the trees may be widely scattered. Tropical forests differ from those of the temperate zone in their great variety. On the woodland acre nearest to your home, you probably cannot locate more than half a dozen different kinds of trees. But an acre in a tropical forest may boast as many as half a hundred different kinds of trees. The sapodilla forest of Yucatán is no exception, and a chiclero can recognize a hundred different trees. Thus, even though the sapodilla trees may be the most numerous, there may be no more than a handful of them scattered through an acre of Juan's forest. These will vary from youngsters six inches in diameter to the mature four-foot oldsters whose dominating crowns tower a hundred feet above the forest floor.

Juan "milks" a tree

Certain sapodilla trees are better producers of latex than others, and so Juan and his companions experimentally whack the trunks of likely trees until a suitable yielder is found. Tapping then commences. Juan makes slanting machete cuts in the bark, one above the other, in a roughly feather-like pattern extending perhaps almost around the trunk. Spurs and a rope enable him to extend his tapping, and he often climbs to precarious heights on the trunk and even onto the larger limbs.

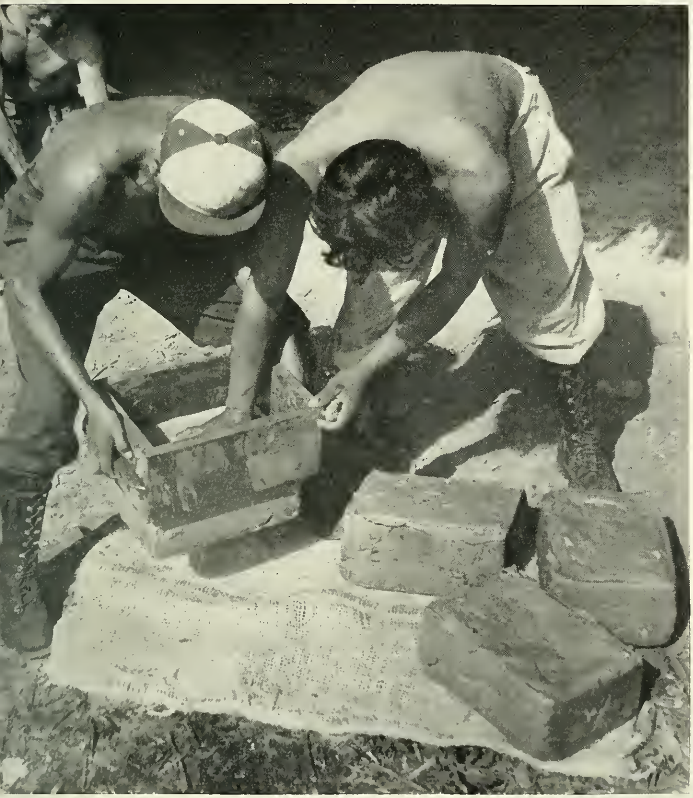
The smooth, milky-white latex oozes from the injured bark and threads its way along the branching cuts down the trunk and eventually drops into the small canvas bag attached to the trunk a few feet from the ground.

As soon as one sapodilla tree is tapped, another is sought, and the tapping process is repeated. With luck, Juan may be able to tap eight trees in a full morning of work.

Later the same day or on the following morning, he picks up the bags and empties them into a larger one, which he throws over his back and carries over the rough trail back to camp. Each tree may yield several pounds of liquid latex during its brief period of milking. Some of the latex solidifies upon exposure to the air and remains in the machete cuts. This is wasted as gum but serves as nature's original sticking plaster, helping the wounds in the bark to heal. (Surgeon's tape, incidentally, has a chicle base.)

If you were to peel off a narrow strip of this dried latex and chew it, you would probably be mimicking the old-time Mayas who used this tasteless, crude latex as the first 100%-American masticatory. A far cry from modern chewing gum, which is usually 80% sugar and flavoring and only 20% insoluble base.

Fresh latex ferments readily and therefore spoils rapidly. So back at camp, the chicleros initiate the first



▲ ...giant bricks of crude chicle are pushed down out of the molds and...

➤ ...carried by mule train to the "main-central" of the contractor

Photos by Kurt Severin

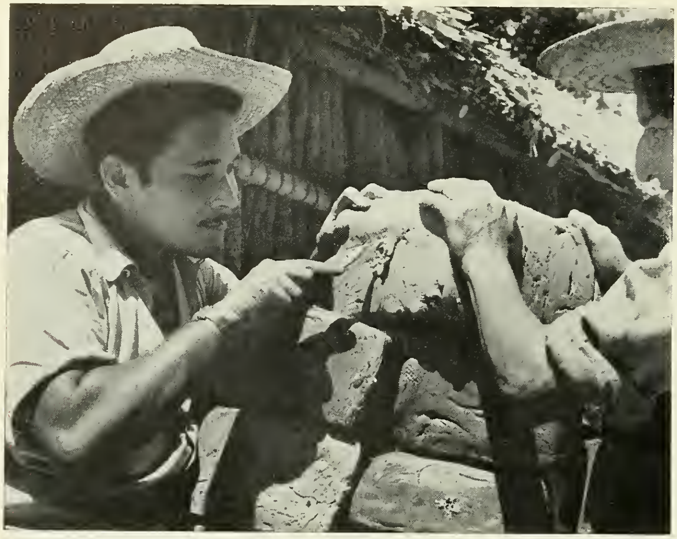


Photo by Kurt Severin

▲ THE CONTRACTOR CHECKS for excessive moisture content (requiring more boiling) before weighing and shipping the crude bricks of chicle

of the changes required to get the liquid into a solid and easily transportable mass. Week ends give respite from the arduous task of hunting and "milking" the trees and so are reserved for the more leisurely process of boiling down the latex. Every chicle camp has its great steaming cauldron. Into this the fresh latex is poured, to be boiled slowly on a low fire until coagulation takes place, often after some three to six hours. Constant stirring is required, for, like animal milk, it will scorch easily. Scorched or unduly smoked latex is inferior and fails to bring premium prices. Juan's associates, as well as his whole family, take turns at stirring, and while each works, the others banter among themselves on their crude jungle doorstep.

Well-cooked chicle loses two-thirds of its original water content and keeps almost indefinitely. It is poured from the cauldron into greased wooden molds, where it hardens within a day. Each mold holds roughly ten kilos (about 22 pounds) of crude chicle, destined for the distant factories.

Not long ago an arduous mule trip was required to bring the crude gum to ports like Belize in British Honduras and Puerto Barrios in neighboring Guatemala. Nowadays, air strips dot the Yucatán peninsula, and the chicleros seldom need to drive their heavily laden mules for more than a day to put their giant bricks of chicle on a plane bound for the coast. Loaded on ships, the gum eventually reaches manufacturing centers in the United States. There it is purified, dried, melted, and finally centrifuged to become the tasteless, highly cohesive substance that will serve as part of the base for chewing gum.

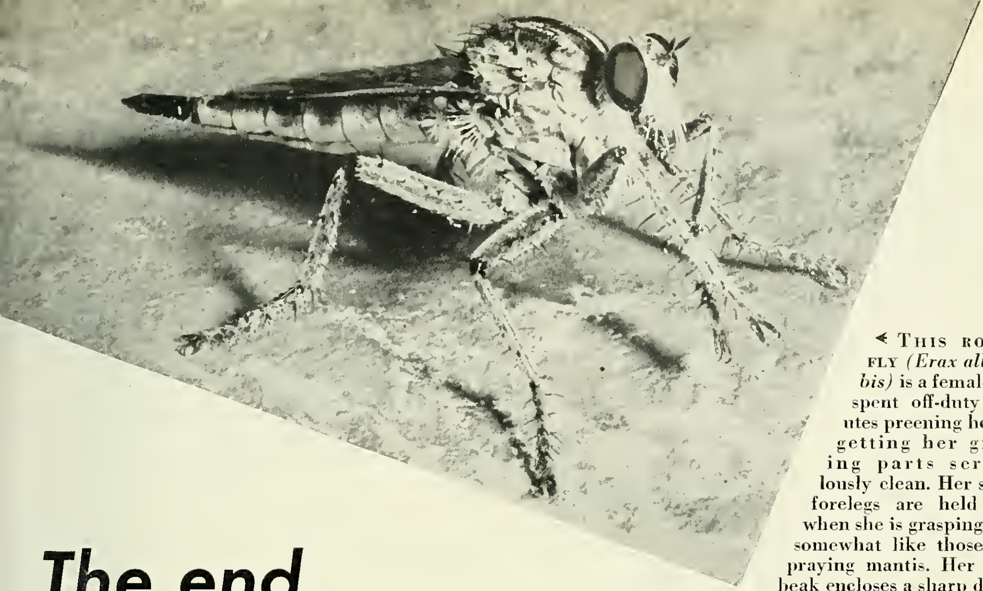
Latex has many uses

Latex of one sort or another comes only from certain plant groups, including the fig, milkweed, dogbane, spurge, and sapodilla families. Latex from various species of these families enters into commerce as such well-known other products as rubber and insulating material. No one knows why certain trees produce latex—not even students of botany. Best guess is that this milky substance serves such purposes as aiding in internal transportation and providing storage centers for waste materials. The resinous pitch of pines, for instance, may act as a protective antiseptic, ready at all times to flow over and cover wounds.

The sharp biting edge of the chiclero's machete, cutting into the bark of a sapodilla tree, severs hundreds of microscopic tubes turgid with latex, from which the fluid is released to fill the wound. Once it is drained out in the tapping process, the mother vessels dry up and are useless for further latex production. New latex is formed only after the wound heals over with new bark, providing new latex-producing cells. This is a slow process, taking half a decade or more. The chiclero must not cut too deeply or he will injure the delicate renewal layer of cambium. Unfortunately, a percentage of the trees are damaged, often so seriously that they either die or can never be bled again for chicle.

The great American habit of chewing gum has spread widely in recent years, resulting in increasing demand for the raw latex materials. Total retail sales of chewing gum now run to around $150 million a year. Since chicleros are paid on a per-pound basis, little heed is given to conservation, and exploitation of the sapodilla forests has been severe down through the years. Upwards of 5% of all trees tapped die either directly or indirectly as a result. With such exploitation, the future of the great sapodilla forests of Yucatán has long been dark.

Trying to postpone the eventual day of reckoning, the chewing gum industry has been utilizing the gum of many other latex-producing species. As likely as not, the gum you next purchase may be totally lacking in the original chicle of Yucatán. Instead, its base, if not synthetic, may be composed of jelutong from trees in Malaya, wild fig latex from Africa, or balata, pendare, or massaranduba from South America. Some day our chewing gum may be made of pure synthetics. If and when that time comes, Juan Cocom's descendants may finally lose one of the last of the bits of Mayan forest lore that have been handed down through so many centuries.



➤ THIS ROBBER FLY *(Erax albibarbis)* is a female. She spent off-duty minutes preening herself, getting her grasping parts scrupulously clean. Her strong forelegs are held high when she is grasping prey, somewhat like those of a praying mantis. Her small beak encloses a sharp dagger

The end of a SKY-FIGHTER

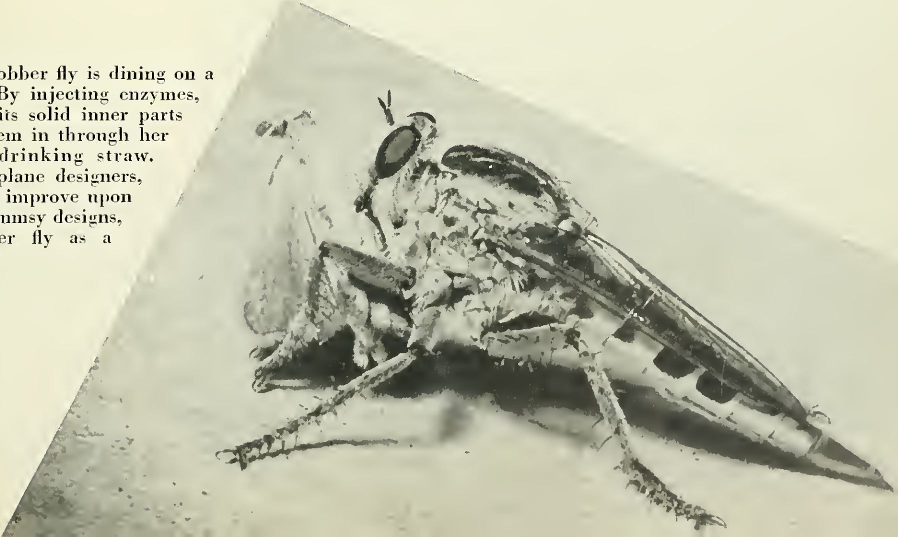
The Robber Fly is well-equipped to rule the insect air-ways, but it too has its enemy

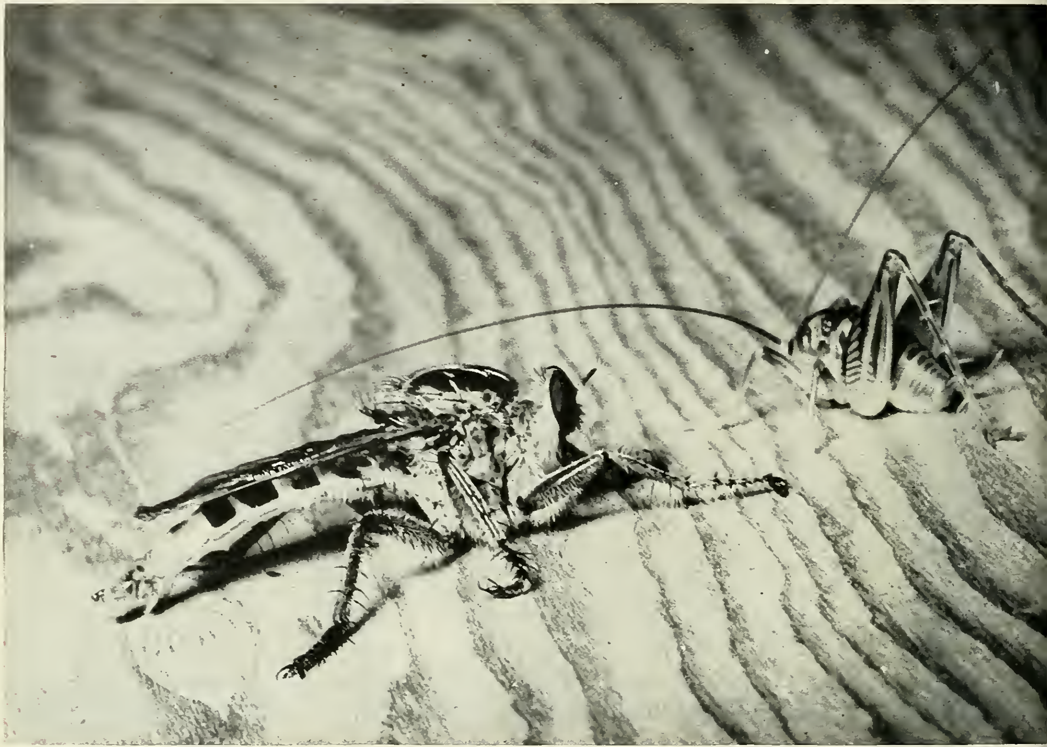
By **JOHN R. CLAWSON**

All photographs by the author

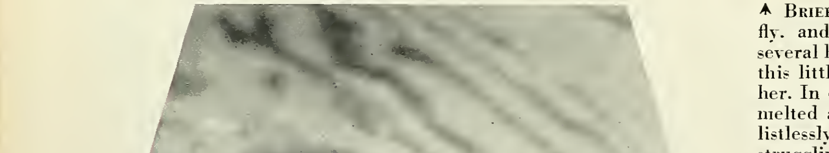
HERE is a creature that carries on an unremitting war against a wide variety of other insects, including some of the worst pests that plague man. It will feed on any it can overpower, including grasshoppers, flies, honeybees, bumblebees, and damsel flies. But it has no taste for warm-blooded creatures and leaves man and his horses and cattle alone. There are several hundred kinds of robber flies in the United States, and some are very swift on the wing. Their seeing equipment rates with the best in the insect world, and they sometimes launch pursuit after prey so fleet that it escapes the human eye.

➤ HERE the robber fly is dining on a white moth. By injecting enzymes, she liquefies its solid inner parts and draws them in through her dagger-like drinking straw. Early-day airplane designers, attempting to improve upon the original clumsy designs, used a robber fly as a model

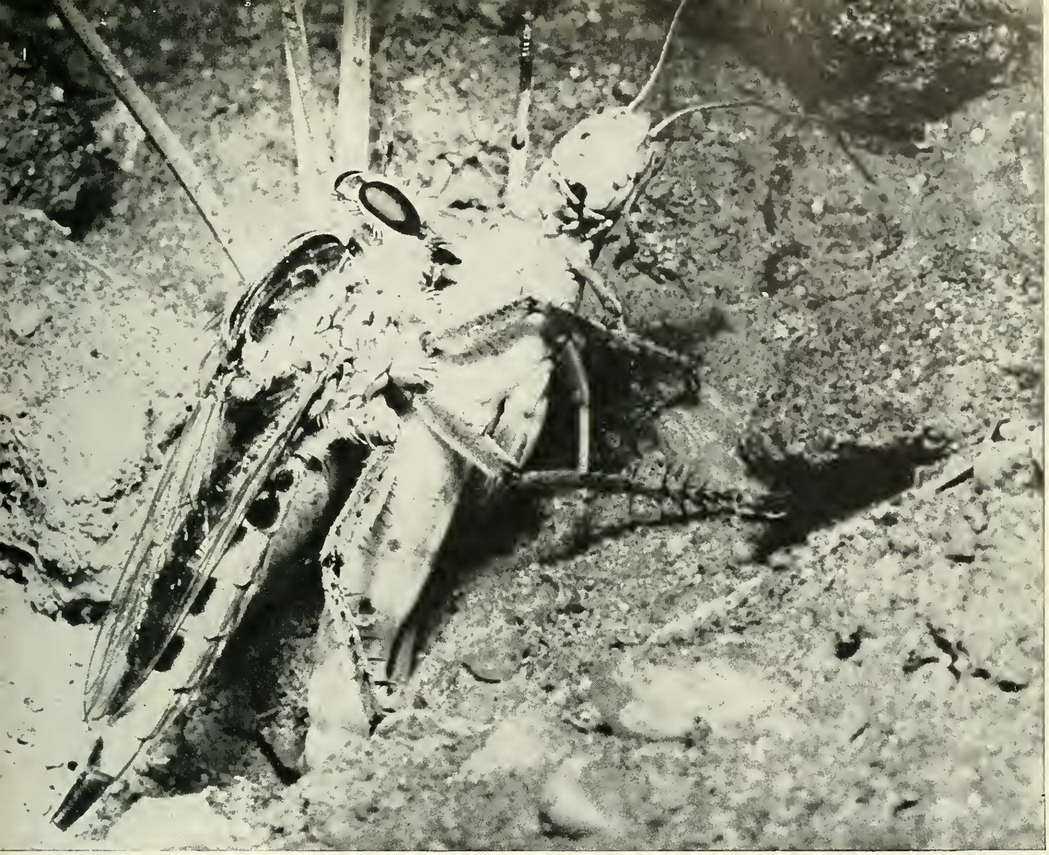




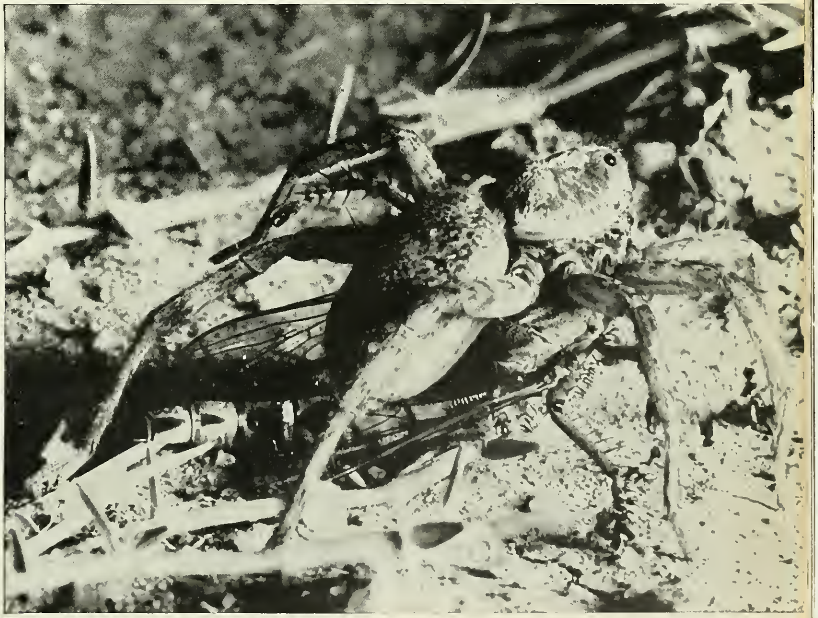
▲ Brief captivity stunned the robber fly. and although she was starved for several hours, she made no attempt to eat this little cave cricket that was given to her. In captivity, her predaceous nature melted and she passed her time sagging listlessly on the floor of her cage or struggling to escape



◀ During her eight hours in captivity, she played possum no less than 31 times, each lasting for from a few seconds to several minutes. Although she lay motionless with her legs curled limply, she could rise and fly with astounding speed once an escape outlet was presented



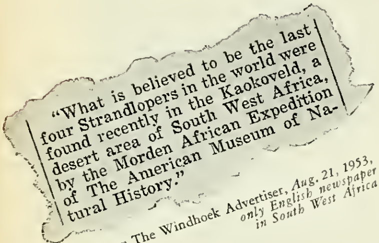
▲ **The robber fly** helps to preserve the balance of nature. Here, a costly crop ravager, the grasshopper, is held helpless



➤ **But just** as the robber fly is a control against certain insect pests, the ground spider is a control against the robber fly. The flying assassin works by day and sleeps by night. Here a ground spider, working late at night, captures a living robber and devours it. So, the robber's work is done. Nature, in the end, is impartial

◂ AT EASE before their primitive shelters of bark, branches, and leaves, the little Strandlopers enjoyed having their pictures taken by the expedition's photographer

THE LAST FOUR *Strandlopers*



"What is believed to be the last four Strandlopers in the world were found recently in the Kaokoveld, a desert area of South West Africa, by the Morden African Expedition of The American Museum of Natural History."

From The Windhoek Advertiser, *Aug. 21, 1953, only English newspaper in South West Africa.*

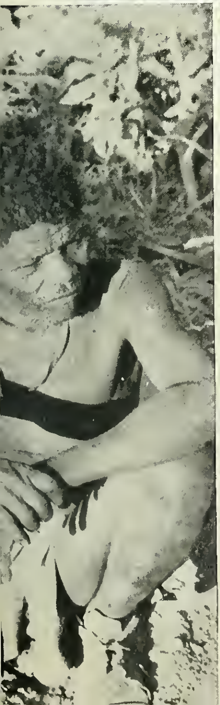
Unable to continue their fight for survival in one of the least hospitable regions in Africa, they have emerged for brief prominence in the twilight of their racial existence

By WILLIAM *and* IRENE MORDEN

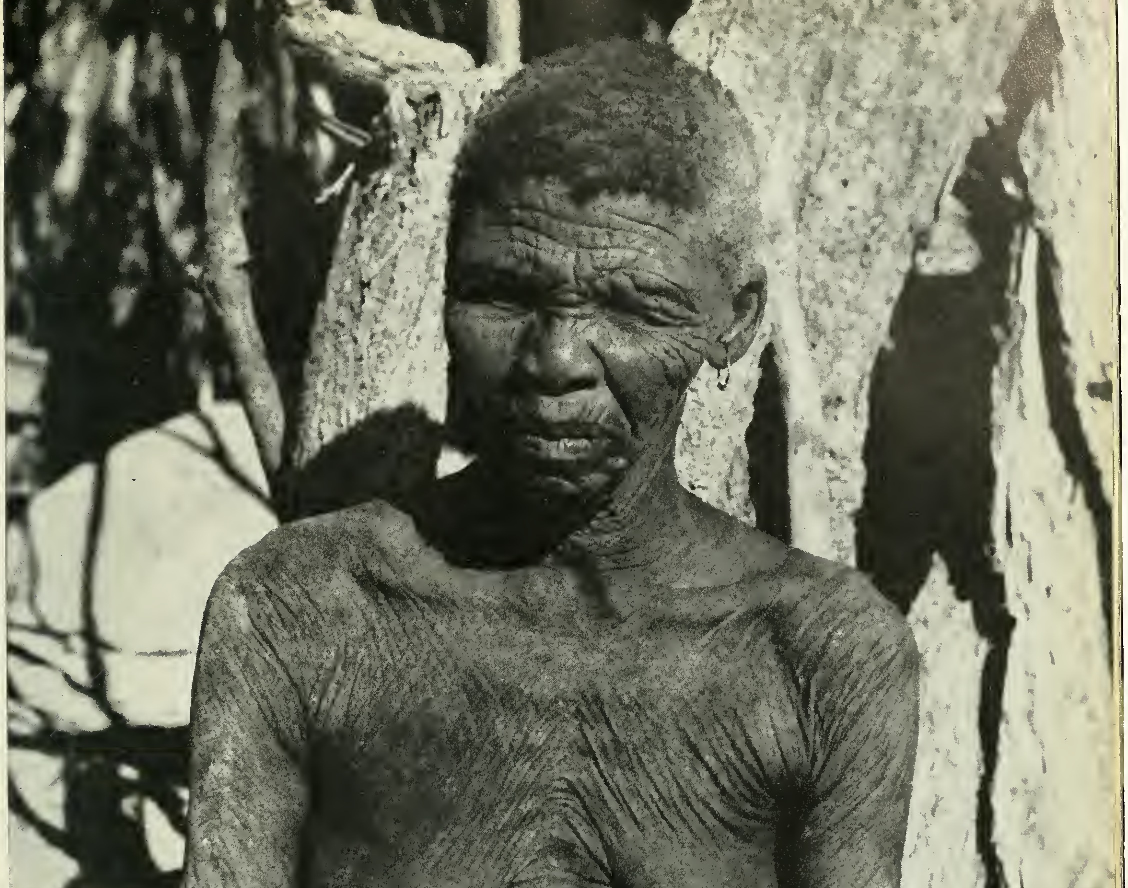
"I am the oldest woman in the world," the old woman muttered.

Her statement could be true. The ancient crone huddling before the primitive shelter that was her home was half blind and so thin that she seemed to be just a wrinkled bag of bones. As she blinked up at us in the sunshine, we felt that we had come face to face with antiquity. Beside her stood three little brown men. They were friendly enough, but silent and watchful at first. These four people were said to be the last of a roving band called the *Strandlopers,* and we had come a long way to find them.

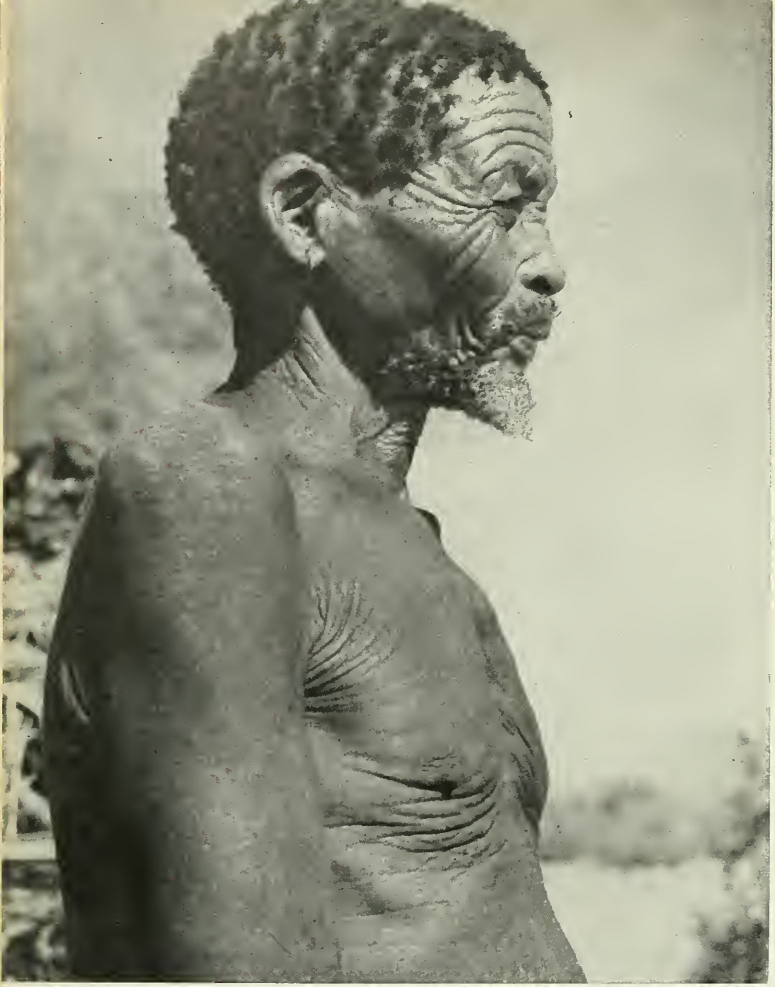
Back in Windhoek, capital city of South West Africa, we had heard stories of the mysterious little Strandlopers, whose Afrikaans name means "Coast Dweller," or "Beachcomber." We were told that once upon a time—no one knows



◄ THE THREE OLD MEN were fascinated by the sound recording instrument and willingly submitted to being interviewed



▲ THE OLD WOMAN was pitifully thin. Her brown skin was wrinkled like elephant hide, and she had long since lost her teeth. She said she was the oldest person in the world



▲ **The Strandlopers** had more facial hair than either the local Hottentots or the distant Bushmen. This man had finer features than the other two

how long ago—small bands of these simple people roamed the wild coast of South West Africa. Their origin is truly obscure. They are not pygmies. Perhaps they are an offshoot of the Bushmen, who are considered the oldest existing group of aboriginals in Africa, or they may even have predated the Bushmen. In any event, the little Strandlopers used to travel up and down their lonely ways subsisting on fish, sea birds, lizards, seeds, and the fruit of the *//naras**, or wild cucumber. They might add meat, roots, and berries to their limited diet if they could find them on their nomadic wanderings. In those early days they left minute trails in the yellow sands where even now few white adventurers care to go.

Not many white men have seen the Strandlopers. Never has the dreaded desert coast where they lived been fully explored, for the approach by land or sea is almost impossible. The heavy sands of the Namib Desert, where dunes sometimes rise to 600 or 700 feet in height, are barren of such food and water as is required by white men. The use of cars and trucks is correspondingly restricted. Treacherous currents, which have wrecked countless vessels, are the terror of navigators who find themselves near those incompletely charted shores. Yet these very hazards once created a natural stronghold for the strange little nomads.

As we listened to stories about the Strandlopers, we grew more determined to seek out the fabled remnant of their tribe. If necessary, we decided, we could take our sturdy Power Wagons across the Namib Desert to the sea in an attempt to locate them. There, weather permitting, we might search up and down the coast for skulls and bones to be classified and studied, if we could not find any living Strandlopers. We were just hopeful enough to believe that some few of the people might still be in existence.

For days we drove past long ridges of purple-blue mountains and masses of gray-green thorn trees. Long since, we had crossed into the savage land beyond all police protection, in that part of South West Africa known as the Kaokoveld. We had traveled over miles and miles of white stony ground, trailing clouds of dust behind us, and we were glad when we reached Sesfontein, a small community in a lovely green oasis fed by the fresh, clear waters of six springs.

Stark against the vast blue dome of the sky stood the crumbling ruins of an old German fort, erected in the days when German soldiers were busy building their white fortresses throughout what was then their territory. The date palms and fig trees they had planted still flourished beside irrigation ditches that fed numerous native gardens. This was the land of the Hottentots, and here, to our great surprise, we found the last Strandlopers.

In this sprawling native settlement in the heart of the Hottentot Reserve, the Hottentot Kaptein, or Headman, told our party that a small company of Strandlopers had drifted seasonally into the village, but each year fewer of them had come. Finally, they had decided to stay on in the little green oasis, where life was easy after their desert ordeals. Having grown too old to fend for themselves on the barren coast, they were living out their few remaining years in comparative comfort.

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* // This sign indicates a clicking sound used in some native languages.

Hottentot hospitality

The Hottentots had received them kindly. The Strandlopers were permitted to reside on the Reservation, but amid the Hottentots' many dome-shaped and matting-covered huts, their modest shelters were a thing apart. Built of bark, grass, and the leaves of the mopane tree, their homes were entirely and characteristically different. On the coast, the framework could have been of whale bones, we were told, but here they were of branches. Their personal possessions were extremely uncomplicated. An animal skin was thrown on the dusty ground. A tiny medicine bag was suspended from a branch, as was a bit of meat hung up to dry. A pail, a stirrer, a fire stick, and a broad wooden dish for grain constituted their utensils. Like some Bushmen we had met previously, these people carried small skin bags to hold their treasures, such as the precious tobacco we gave them. The men did not own bows and arrows. They seemed to be dependent on the generosity of the Hottentots for meat.

Our Strandlopers were of a medium brown color. They were about five feet tall and slight in build. In fact, at that time they were so emaciated that we could see their hearts beating against their brown skins as though they had no protective chest covering. Gray funguslike patches showed on their bodies, and their general condition suggested many dietary deficiencies. Their wooly hair was closely matted, and the tight black curls resembled small peppercorns. Their features were not coarse, and their expressions were moderately animated. Their eyes were dark and deep-set. While the men did not seem to be overly intelligent, they were good-humored, and they thoroughly enjoyed the attention we gave them.

We had the first motion picture cameras "on location" in the Kaokoveld. We found the Strandlopers to be natural actors in their simple roles. They really took to the movie business like ducks to water. Even the frail old woman, who could scarcely stand alone, wanted to take part. She was helped about by her son, a tall half-breed resulting from her marriage to a black Klip Kaffir. Her husband, much younger and more energetic than the men of her own race, was much in evidence. He dashed about with all the importance of an impresario and seemed to be constantly underfoot. He demanded that his wife—our feminine lead—be placed here or seated there to suit his fancy, not ours! This officious Klip Kaffir in his skin apron and wearing a skin cap with a long animal tail dangling down his back, made an entertaining but often annoying assistant in our production.

Our interpreter was of a different stripe. He was a serious young Hottentot who had been educated up to the sixth grade at the Rhenish Mission in Okahandja, South West Africa. He had come back home to teach in a small school, the only one in the Kaokoveld. In addition to his native tongue, Nama, this young teacher spoke a little of both Afrikaans and English, the two official languages of the Union of South Africa. He had some knowledge of German as well. Thus, Nikodemus Hendrik could translate into Afrikaans what the Strandlopers had to say in Nama, the language they had adopted from the Hottentots. This information was then carried on into English by members of our Expedition. Fortunately, two of our party spoke Nama

AFRICA
Sesfontein
Windhoek
SOUTH WEST AFRICA

ESFONTEIN, where Strandlopers were ound, is 340 miles from Windhoek

▼ MUCH OF THE REGION known as the Kaokoveld is sandy, and the winches of the Power Wagons came into frequent use

▲ A FACE seamed through long exposure to the desert climate

also, so that we were able to double check on the information obtained.

The inhabitants of the village were amused by the activity of our small group. They watched with interest as we hurried about, making our arrangements for taking pictures and for recording the native voices. In a dignified way, the Hottentots gathered round us, and their Kaptein with his native councillors remained at hand in case we needed their assistance. Although the Hottentots have been killers in their day, they proved most amenable during our visit and kept at a suitable distance while we were photographing the Strandlopers.

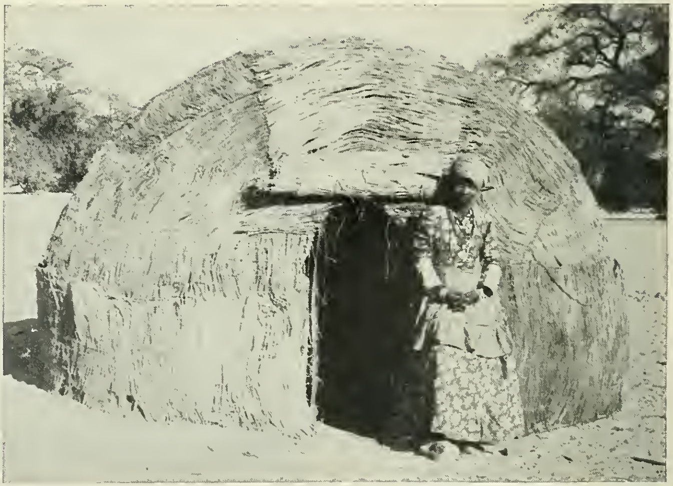
When we had finished "shooting" our motion pictures, we got out the recording machine. The Strandlopers were tremendously interested in it and were eager to touch the equipment. However, with the politeness characteristic of so many Africans, they kept well back until we invited them to make a recording. At first their voices were low. It was difficult to get them to speak out, for they were shy. It took us some time to gain their confidence, but finally they began to tell us about a lion hunt. It ran like this:

"One day there was a lion . . . I saw the lion . . . that day there was a lion, and I saw it . . ." and so on. No climax.

We tried to find out if the self-styled hunter had really hunted the lion or even followed its spoor. He seemed unable to tell us exactly what had happened, and the story just dwindled away. While the story-teller talked into the machine, the other two old men laughed continuously, so much so that we suspected the "lion hunt" of being a hoax.

Later, when we played the recording back for them, the three old fellows couldn't stop laughing. Had they ever really hunted lion? We could not know. There are lions in the Kaokoveld, and it is possible that, at some time, the small brown

▼ THIS NEAT HOTTENTOT HUT is an elegant dwelling compared with the simple shelters of the Strandlopers, who are permitted to live on the Hottentot Reserve. The brightly colored cotton dress worn by this Hottentot woman shows the fashion set by missionaries many years ago



men had tracked one down. But we doubted that one of them had killed it.

The old woman had been resting in her shelter. Now she roused herself to tell us a story concerning the origin of her tribe.

"It was long ago," she mumbled to Nikodemus Hendrik. "A man and woman with their dog traveled north from the place where two oceans meet [The Cape?]. Soon their food gave out, and the people of the north [Bushmen?] would not give them anything to eat. They wandered to the coast and managed to make a shelter, but now they were starving."

Here she had to stop and lie down in the shade of her hut for a little while. Then, refreshed with a drink of sour milk from a calabash, she went on:

"The dog ran up to a green thorny vine growing in an *omuramba*, or dry river bed, and ate of the fruit. The man watched the dog eat from the unknown vine, then he said to the woman, 'Our dog has eaten of this fruit. He still lives. I will eat of it also. If I am alive tonight, then you may eat, and we shall be saved. If I die, then you must take the dog and try to go back to our people.' The man then ate of the wild cucumber. It was good. That night he gave some to his wife. They lived. They settled on the coast, where their children were born. There they stayed for many years."

Now the old woman sighed and stopped. She had been sitting up resting her back against her son's knees, but she was too feeble to go on. He laid her gently on the ground again, and she drifted off to sleep. Her tall son finished the story by saying that from then on, the Strandlopers blessed the *//naras* vine, for they knew that its fruit would always keep them alive.

▲ THE THIRD MAN was the one who gave an account of a doubtful lion hunt. His speech was slow and halting, but he was good-natured about the teasing he received from his companions while trying to tell his story

Was the legend true?

Although no one knows exactly how the movement of people took place so many centuries ago, it is possible that the old woman's story is essentially correct. If succeeding waves of native population from Central Africa took them down to Cape Province, it is likely that later fluctuations carried some of the people north and west to scatter along the shores of the Atlantic Ocean. These could have become the coast tribes of which we had heard.

About three years ago, it was said that there were ten or eleven Strandlopers left. Now there were only four. The Strandlopers are passing from the scene, as are the Bushmen and the Hottentots. Sickness, starvation, veld fires cutting off access to inland areas, wild animals, and unfriendly natives have all contributed to the slow death of these primitive people.

The four little Strandlopers cannot leave Sesfontein. They are too old. They have made their last trek across the yellow sands of the Namib, and when these last four have passed away, it will be the end of their race.

After Nikodemus had finished his interpreting and our recordings had been made, we realized that it would not be long before these strange voices would be stilled forever. We said solemnly to one another that we might well be the last white people ever to see these odd folk—the Strandlopers.

Nature's Oddities

the Stargazer

Occasionally dredged up from the sandy Chesapeake bottom is a sluggish, bizarre-looking fish with a startling secret weapon

By Alice Jane O'Brien

All photographs by the author

SHOCKING discoveries of one sort or another usually leave an indelible impression on one's mind. My most electrifying experience left me weak, shuddering, and slightly indignant.

One evening about dusk in mid-Chesapeake Bay area, a friend and I slowly poled our small skiff, dipping for crabs in the shallow coves of the Patuxent River estuary near the Chesapeake Biological Laboratory at Solomons, Maryland. As we languidly moved about, I noticed a peculiar, club-shaped fish about a foot long with an English bulldog snout. It was moving sluggishly along the bottom but was nearly imperceptible because its murky-brown color blended with the sand.

"Oh, that's only an old toadfish," said my companion. "We see them all the time."

But I was still curious, and I dipped the fish up with my net and drew it into the boat. When I grabbed it with one hand, I screamed loudly and nearly fell out of the boat as I hurled the fish to the deck.

I had received an electric shock!

The creature on the floor danced a mad staccato beat. It gasped spasmodically with strangely-fringed lips and stared up with a seemingly soulful, accusing gaze.

Never before had I seen such a bizarre excuse for a fish. Its head was wide and completely flat on top. Especially prominent were the eyes, set like jewels flat on a muddy mass of flesh. Its gaze seemed to be directed permanently skyward.

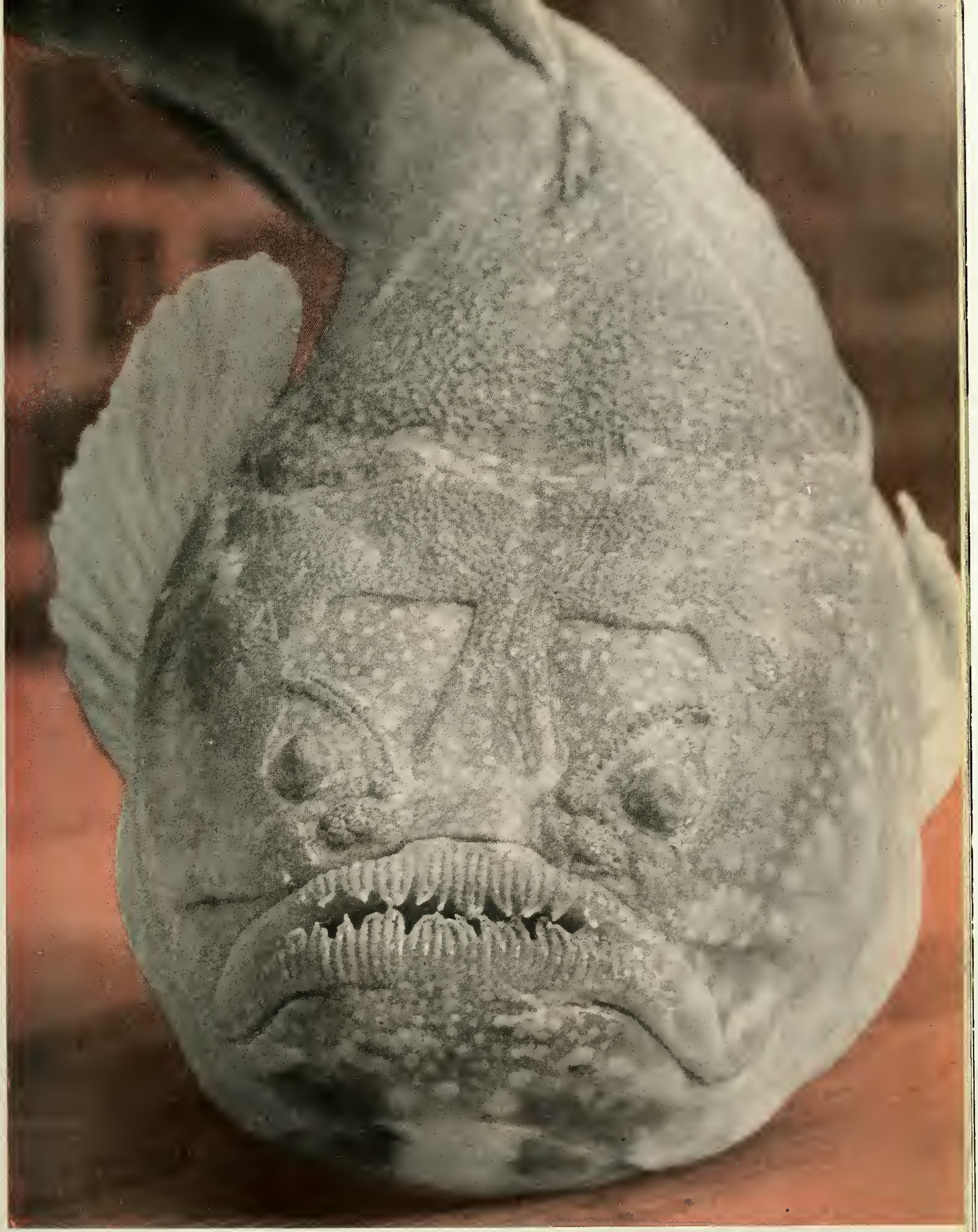
"Afraid of a poor little toadfish like that!" my companion remarked. But his scorn vanished when he reached down and grasped the fish himself.

"Ouch!" he yelled, releasing the fish immediately. Unfortunately, this time the fish flopped out of the boat and dove for the bottom, raising a cloud of sand as it hit. Hoping to glimpse it again, we waited until the sand settled, but the fish had disappeared.

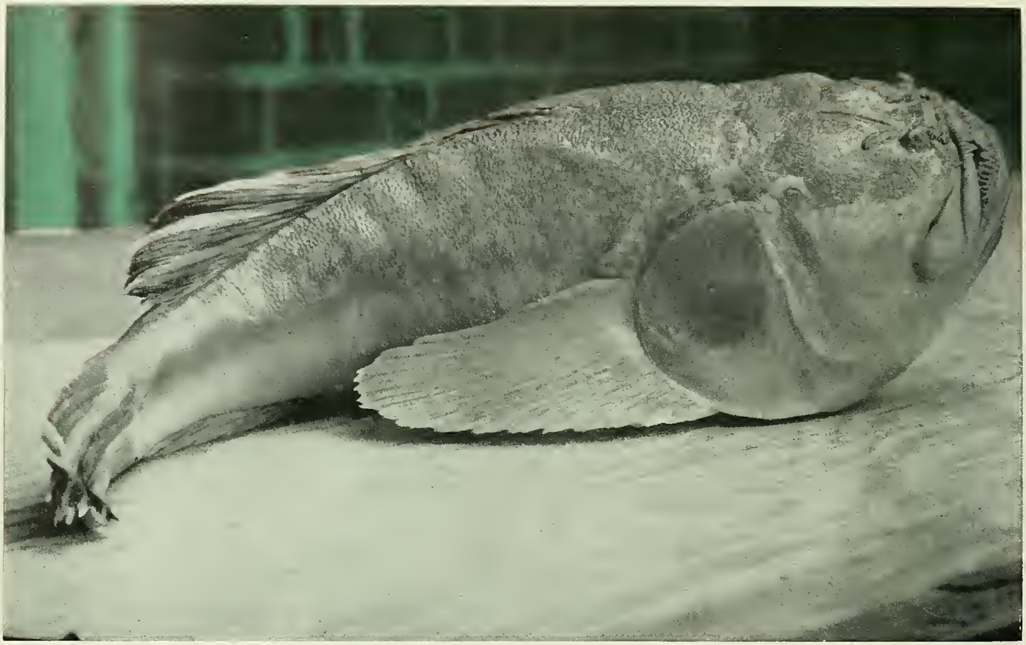
Curious about the little fish's ability to give an electric shock, we searched in various ichthyological tomes, trying to identify it. After flipping pages here and there, we were pleasantly surprised to find that the fish was dubbed, appropriately enough, the "stargazer." Fish scientists knew, of course, that it could deliver an electric shock when grasped on the head close to the eyes. My friend and I both had taken hold of our stargazer by that part of its anatomy, trying to keep its wide mouth clamped shut.

Amateurs though we are, we had always been proud of our knowledge of marine life, so our ignorance about the stargazer had taken us down a few notches. Our chagrin, however, was relieved by a musty old news clipping we found. In 1937, *The Baltimore Sun* ran a headline, "Dr. Beebe unable to identify strange fish caught in Bay." The article began with, "William Beebe, B. S., Sc.D., LL.D., author of *Half a Mile Down*, coauthor of *Field Book of the Shore Fishes of Bermuda*, et al., explorer of the ocean depths in his bathysphere, took one look at an eight-inch fish [from Chesapeake Bay] and shook his head." Later, of course, he identified the fish as a stargazer. It is not actually an extremely rare fish, but it is uncommon enough so that Dr. Beebe had not come in contact with it previously.

The fish delivers its shock from two smooth, naked, rectangular areas just behind the eyes and along each side of a bony Y-shaped structure on top of its head. This



▲ Not an ancient Mexican carving, but an actual fish. The fierce-looking mouth is created by sand-filtering fringes on the lips



▲ RARELY EXCEEDING 10 inches in length, the stargazer has a club-shaped body and a bulldog snout. Eyes are fixed skyward

structure looks as if someone had taken a Y-shaped piece of rubber an inch long and glued it between the fish's eyes.

The electric personality that the stargazer cherishes is not unique among fishes. Most people at one time or another have heard also of the electric ray, or torpedo, the electric eel, and the electric catfish.* Dr. C. Ladd Prosser, Professor of Physiology at the University of Illinois, who has conducted a great deal of research on electricity in fishes, states that certain muscles change when the fish is very young into a series of numerous electric plates. These are called "electroplaxes." The flat upper surface of each plate receives nerves which activate it, and the bottom surface has many tiny fingers, known as papillae, which receive the nourishing blood vessels. In the stargazer, two eye muscles have been converted into groups of these electric plates; consequently, the electric organs are immediately behind the eyes. When a stargazer has been stimulated, either by human hands or perhaps by an enemy, or food in the water, each group of plates fires repeatedly.

How much of a shock can a stargazer produce? Looking at it objectively, I have to admit that an electric eel would be worse, for it is much larger and its electric tissues occupy a greater proportion of its body. An electric eel has been known to drown a horse. But even a six-inch stargazer can give a perceptible shock, and a freshly-charged 12-inch specimen like the one I grabbed will always get a wide berth so far as I'm concerned.

From our boat, we observed that the stargazer was a bottom-dweller, either living quite close to or actually burying itself in the sandy floor of the bay. It moved slowly, as do most other fishes with electric organs. They are more likely to catch their prey by shocking it than by scurrying around after it. In fact, if we had been crab-dipping earlier in the day, we would have missed the stargazer, as they habitually spend their days buried in the sand.

The disappearing act of the stargazer faintly resembles the mambo dance. The fish buries itself with a side-to-side, squirming motion, usually leaving only the top of the head and tip of the tailfin visible. Not only does it bury itself to wait for food, but also to escape approaching foes. There is a flurry as the fish digs into the sand, and a cloud hides its escape. In emergencies, the stargazer is able to go as deep as 12 inches, making it difficult for the most persistent enemy to dislodge it.

The stargazer possesses several amazing adaptations, which Dr. Ulric Dahlgren, a well-known physiologist, has described in detail. For example, the upper surface of the head is flat clear to the tip of the snout, causing the eyes to lie flat on the top of the head. This per-

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*See "Electric Fishes," by N. J. Berrill, *Natural History* for December, 1953.—ED.

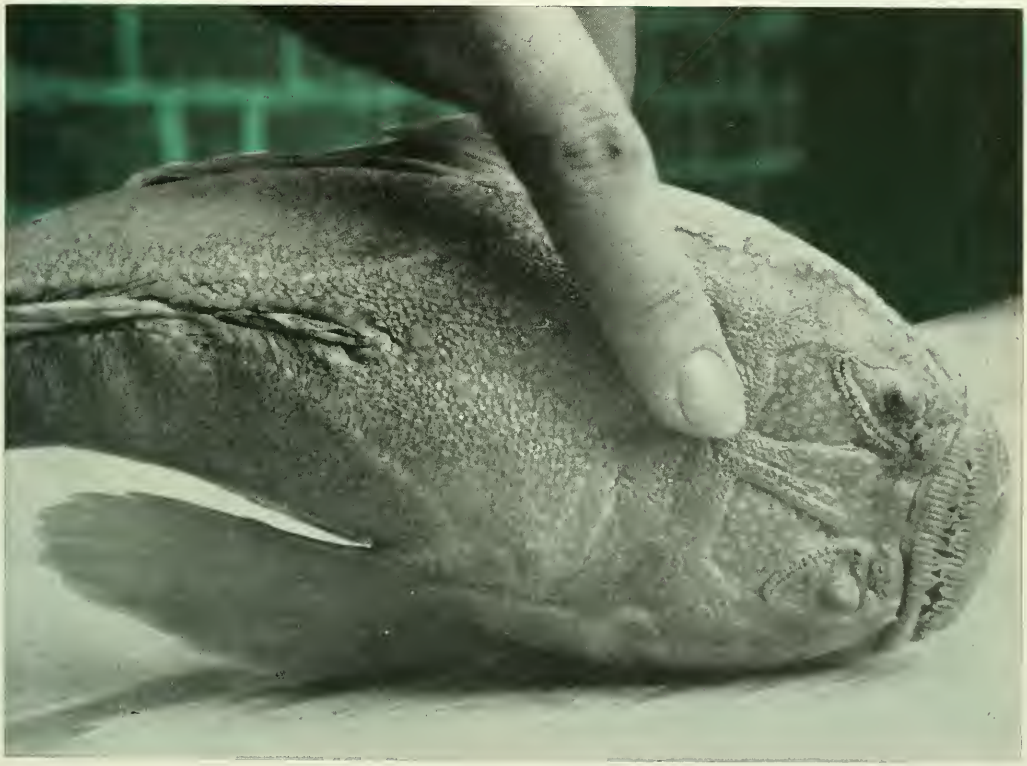
mits the fish to submerge and conceal itself almost completely, yet allows its eyes and mouth to function properly. Also, the fins are well developed and placed in a position to facilitate digging. The "shoulder" fins are about as low as they could be, and are widely spread, almost like a pair of shovels fanning out from the fish on both sides. When small fishes, isopods, and other small invertebrates swim within grasp, the stargazer quickly emerges, opens its upturned mouth, and engulfs its supper.

Stargazers are primarily ocean fish, liking warm, salty waters, but they will migrate into places like Chesapeake Bay, at least during the summer months.

At spawning season, they apparently swim to deeper ocean waters. The baby stargazers do not resemble their parents until they are about one inch long. When hatched, they resemble the more conventional fishes in shape, with eyes on the sides of the head and mouth horizontally placed. Later the eyes move to the top of the head. The adults rarely grow over a foot long; most of those in the United States vary from six to twelve inches.

Few creatures have scientific and popular names that are more nearly identical. The generic name of the stargazer is *Astroscopus,* from *astra,* meaning "star," and *scopus* meaning "to look." The specimen that caused so much commotion in our boat belonged to the more northern species, named *Astroscopus guttatus,* meaning the stargazer that is "spotted like rain drops," for it has pale brown spots on the darker brown back.

A friend once asked, "What good is this crazy-looking fish?" For a moment, I was stymied. Certain fishermen in Chesapeake Bay are known to have eaten them, and its relatives reach better eating size in the Mediterranean Sea and in waters around Japan, New Zealand, and the East Indies. But I searched my mind to justify the poor creature's existence. My final reply was that scientists studying the electrical organs of fishes contribute to the better understanding of the muscular-neural processes, which may benefit medical science. Such a goal sounds rather distant, yet astounding discoveries have been made through study of the physiology of such unusual animals. In any case, I concluded that the stargazer would remain the most unforgettable character in my life.



▼ SMOOTH AREAS, suggesting "eyebrows," produce the electric shock that startles fishermen. Strength of the jolt grows with the fish

Typical daily cycle includes a "tub" bath . . .

a twice-reduced HIPPOPOTAMUS

Leathery, pop-eyed, and pig-tailed, the baby pygmy hippo is smaller than a fox terrier

. . . a nourishing quart of milk . . .

THIS wistful little creature is a far cry from what we usually think of as a hippopotamus, and in a way it should be, for the animal pictured here is a very young *Pygmy* Hippopotamus (*choeropsis liberiensis*).

Even when full grown it will weigh only about one-tenth as much as the circus hippo that most of us gaped at as youngsters (600 pounds vs. three tons). Unlike its giant relative, which is dispersed widely throughout the Dark Continent, the pygmy hippo is confined to the western rivers of Africa, particularly those in Liberia.

Published accounts state that its habits are more like those of a pig than a typical hippopotamus, and that it spends most of its

. . . an apple fortified with vitamins . . .

▸ . . . protective towel to ward off chills . . .

Photo series by Kurt Severin
from Camera Clix

time in the forests, entering the water only to bathe or cross a river. Apparently it does not associate in herds, but in pairs. Like the common hippopotamus, it is strictly a nocturnal animal, coming out at night to forage on young shoots, fruits, and grass.

The specimen here was being cared for temporarily by a Long Island animal collector before shipment to a Midwestern zoo, and at the time was about 15 inches long and 10 inches high. At maturity it will be about six feet long and perhaps three feet high. Food consisted of fresh fruits and vegetables, milk and vitamin pills. To keep its skin from getting too dry and wrinkled, the affectionate little animal was given several baths and showers a day.

▾ . . . and a shower for that lovely complexion.

Photo by Paul A. Moore, Tennessee Conservation Dept.

▲ THE TRANQUILITY of this typical Reelfoot fishing camp makes it seem incredible that the lake was created by an earthquake. Camps like this are numerous along the southern shore and have become famous for their fried catfish, fresh cole slaw, and succulent "hush puppies" (french-fried corn bread)

REELFOOT LAKE—Child of Violence

One of the largest earthquakes
in United States history produced a naturalist's paradise

By JESSE C. BURT

ON the 16th of December, 1811, at about 2:00 A.M., there was a violent earthquake, accompanied by "a very awful noise," as Eliza Bryan of New Madrid, Missouri, put it. "The screams of the inhabitants, the cries of the fowls and beasts of every species, and the roaring of the Mississippi . . . formed a scene most truly horrible," she wrote to her minister. The quake was felt 1100 miles away in Boston, and from the headwaters of the Missouri to the Gulf of Mexico—over a total area of about a million square miles.

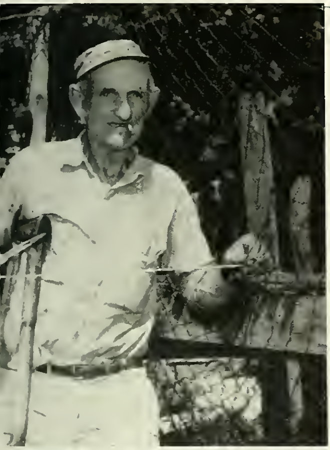
When the sulphurous vapor that filled the air cleared away (it was probably marsh gases released by the disturbed swamp areas), a lake lay across the Mississippi River from where Eliza Bryan lived—a lake that has delighted and puzzled all who have paused to look into its secrets.

An earthquake in the Mississippi Valley? We think of California, Japan, and other mountainous areas as having a corner on earthquakes. As the *Atlantic Monthly* put it in 1869, the occurrence of such a shock in such a region was "unprecedented in the history of earthquakes." And in 1912, a century after the event, no less a publication than the Bulletin of the United States Geological Survey said that the so-called New Madrid shocks have not been surpassed or even equalled by the more recent and better-known quakes at Charleston and San Francisco. They proved that even a placid valley can tremble and toss.

From John James Audubon to Roger Tory Peterson of the present day, naturalists have found "happy hunting" in and around the 15-mile body of water known as Reelfoot Lake, in the northwestern corner of Tennessee. Audubon had the luck to be exploring in Kentucky not 100 miles away when one of the great shocks came. He tells how he thought his horse had suddenly foundered. Speaking to the animal, Audubon was on the point of dismounting when the horse spread out his forelegs, as if to save himself from falling, and stood stock still, groaning. "I thought my horse was about to die," he wrote, "but at that instant, all the shrubs and trees began to move from their very roots, the ground rose in successive furrows, like the ruffled waters of a lake, and I became bewildered in all my senses."

The shocks lasted more than a year and affected most seriously a then sparsely-populated area of 30,000 to 50,000 square miles in adjacent areas of Missouri, Arkansas, Kentucky, and Tennessee. Plaster cracked at Charleston; church-

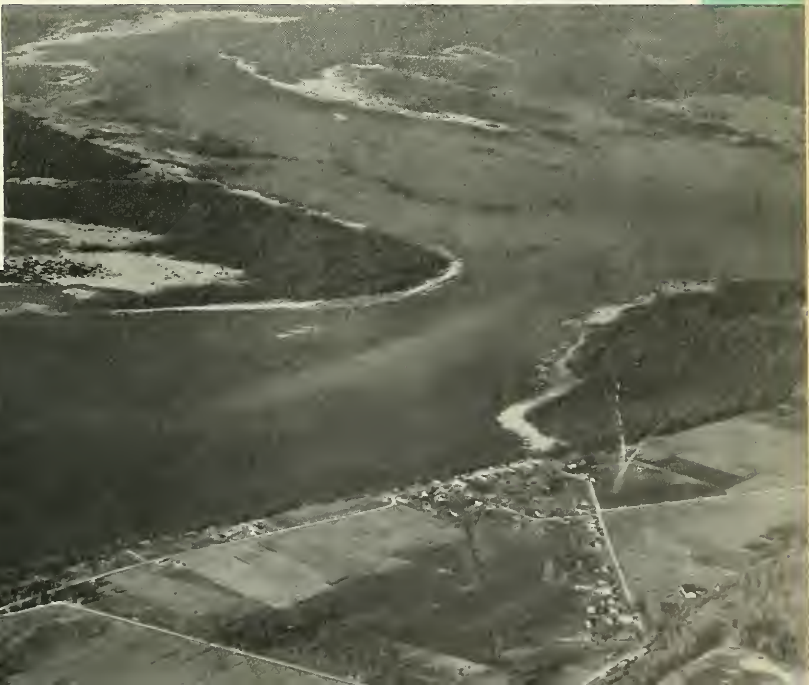
Photo by Dan Cravens, Nashville Tennessean



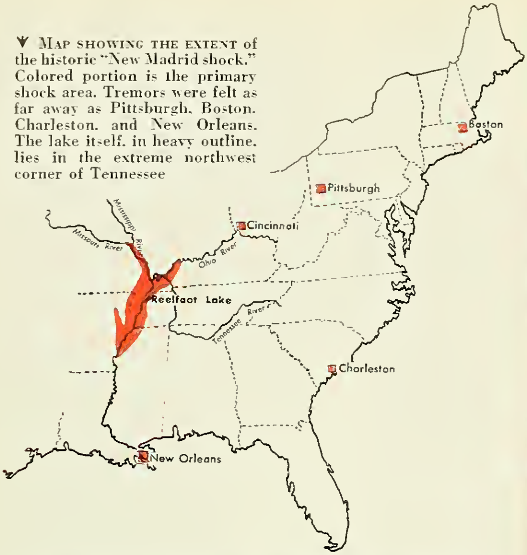
◄ A REELFOOT FISHERMAN mends his nets. The lake has long been a source of food for near-by markets. Thousands of pounds of fish and turtles are shipped out weekly.

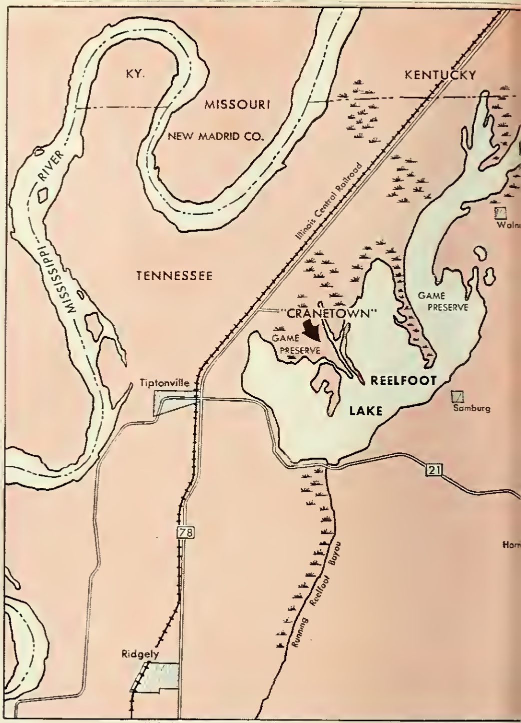
▼ AERIAL VIEW of Reelfoot Lake, looking north. The town of Samburg is at the lower right. For its size, the lake is extremely shallow, and its surface is pockmarked with upthrust tree stumps. Much of the shore line is accessible only by boat

Photo by Paul A. Moore, Tennessee Conservation Dept.



▼ MAP SHOWING THE EXTENT of the historic "New Madrid shock." Colored portion is the primary shock area. Tremors were felt as far away as Pittsburgh, Boston, Charleston, and New Orleans. The lake itself, in heavy outline, lies in the extreme northwest corner of Tennessee





➤ IRREGULAR SHORE LINE offers countless intriguing side trips for the exploring fisherman or naturalist. Most of the human habitation is on the southeastern shore, with Tiptonville (population 2000) as the largest community. Note "Cranetown," described by artist-author Roger Tory Peterson as one of the finest heron rookeries in the world. Thousands of double-crested cormorants, great blue herons, and American egrets nest there each year, along with a scattering of anhingas (water turkeys) and black-crowned night herons

bells rang at weird hours at Richmond; pictures and mirrors fell at Pittsburgh and chimneys collapsed at Cincinnati. Two thousand separate shocks were felt at Louisville, many at New Orleans, and some even in Canada. Over a wide area, panic resulted; and many thought the earth had come to an end.

Below New Madrid, the river bed was described as cracking open, then coming together to vomit large volumes of mud, sand, and water in an awesome geyser. Several river islands simply disappeared, at least one before the horrified eyes of an observer. Caruthersville, Missouri, slid into the churning waters.

Yet the fury in the wilderness caused only one recorded life to be lost, and this was the death of a New Madrid woman so frightened that she ran herself to death.

Sir Charles Lyell, distinguished British geologist, made a field trip to New Madrid. He heard that the slight loss of life was due to frontier resourcefulness. Sir Charles later wrote that the inhabitants, with typical pioneer pluck, studied the direction of the cracks in the ground, felled tall trees so as to span them, and thus saved many persons from being lost.

The years 1811, 1812, and 1813 were marked by seismic activity in many other places, as in California, on the island of Sabrina in the Azores, and at New Granada in the West Indies. The volcano Soufrière erupted on the island of St. Vincent in the British West Indies; and on March 26, 1812, a terrific earthquake occurred at Caracas, Venezuela, killing 10,000 persons. But Reelfoot Lake was the most unusual prodigy to which all this violence gave birth.

It is common to measure an earthquake's violence by the number of persons it kills and its damage to man-made structures. But at Reelfoot Lake, the impressive thing is not what nature destroyed but what she created. As Dr. Clarence Cottam of the United States Fish and Wildlife Service so aptly stated, "Reelfoot Lake is a master product of nature, an area of unique and intriguing charm, with no counterpart on this continent. It is an area of outstanding scientific interest, of high recreational value, and of still greater economic worth."

The West Tennessee Chickasaw Indians were not long in creating a legend about the lake. The story tells about the desperate love of a crippled Chickasaw chief named Reelfoot for the lovely Choctaw princess, Laughing Eyes. He was called Reelfoot because he reeled when he walked. Laughing Eyes lived near New Madrid. Reelfoot asked her father for her hand in marriage, but the father did not want Laughing Eyes to marry a crippled man. Though this hurt Reelfoot, he promised he would try to forget the princess. But Reelfoot couldn't forget Laughing Eyes. One night, he and some of his braves stole across the Mississippi and abducted Laughing Eyes, apparently without much persuasion.

Photo by Paul A. Moore, Tennessee Conservation Dept.

▲ BAYOUS SEEM OUT OF PLACE this far north, but they're here. Swollen-based cypress trees and spreading water lilies create an almost tropical atmosphere

A great marriage feast was held, and the fires blazed high. Then, suddenly, the Father of Waters, angered at Reelfoot for breaking his word, turned back on his course and washed over the camp. The resulting lake was named after Reelfoot.

The geologists explain

The facts, though less personalized, are dramatic in their way. Dr. L. C. Glenn, longtime head of the Department of Geology at Vanderbilt University, looked below the lake in his effort to explain its origin. Stresses in the hard Paleozoic rocks of the Gulf Embayment floor, he said, caused the slippings or faultings that were felt above on the horrible morning of December 16, 1811. The shallow depression occupied by Reelfoot Lake reflects the modifications in the rocks.

Another scientist, Dr. Myron L. Fuller, wrote similarly about the New Madrid earthquake, in the Bulletin of the U. S. Geological Survey, but he added something. He indicated that if the region should again have an earthquake, the drainage system of the Mississippi might well be drastically altered. On the occasion of the New Madrid quake, it was reported that the river flowed upstream for three days. However, a great deal of hysteria no doubt colored the on-the-spot reports. Rising and sinking of the land seems to have amounted to approximately 15 feet each way over considerable areas, and these motions, combined with extensive landslides along the banks, no doubt resulted in very turbulent conditions in the Mississippi. Strong upstream waves (similar to miniature tidal waves), associated with currents caused by draining off of the water to fill the depressions, gave the effect of the river flowing upstream. But it can hardly have done so for three days.

▼ EVERY FLOATING LOG in Reelfoot seems to carry a convention of sun-worshipping turtles

Photo by Maslowski and Goodpaster

Photo by Don Crovens, Nashville Tennessean

▲ HUGE TREES, dense undergrowth, and a pervading "wetness" characterize life on the shores of the lake

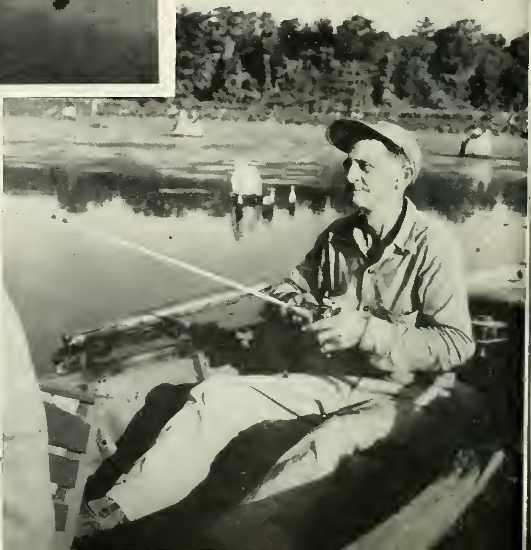
The basin that Reelfoot Lake occupies was made by the earthquake, and the lake is fed by Indian and Reelfoot Creeks as well as by Bayou de Chien (which was named by the French explorers, as New Madrid was named by the Spanish). Reelfoot's water is the color of clear, thin coffee. Since 1951, the Reelfoot Lake basin has been studied by the U. S. Corps of Engineers and the Mississippi River Commission for its obvious utility as a water holder.

For many years, the natural life of Reelfoot Lake has evoked such adjectives as "teeming," "prolific," and "fantastic." A series of important articles have been written by a tall, wiry student of nature who has visited the lake annually since 1915. This is Dr. George R. Mayfield, former head of Vanderbilt University's Department of German, a Phi Beta Kappa, world traveler, friend of Dr. Roger Tory Peterson and other outstanding ornithologists, and Chairman of the Tennessee Conservation Commission. Dr. Mayfield told a friend recently that when he first saw Reelfoot Lake, he felt like Cortez viewing the Pacific in Keats' famous poem. He added, "There is scarcely an area of equal size on the face of the globe that so abounds in interesting flora, fauna, and humanity."

Photos by Don Cravens, Nashville Tennessean

▲ FISHING IS UNSURPASSED. Sportsmen from many states come to take their share of seemingly limitless numbers of bass, bream, bluegill, crappie, buffalo and catfish. One angler can fill a portable icebox with panfish in a single morning

➤ SOLID COMFORT in a Reelfoot Lake boat. All newcomers are intrigued by these novel boats, which were designed specially for safe operation in snag-studded waters and smooth passage over dense mats of water lilies. Their draft is shallow, and they are often metal-sheathed. Oars are reverse-action type, so you can see where you're going. Many, like this one, have inboard motors, with propeller and rudder shielded from submerged stumps by a heavy metal skid



Fishermen, black and white. Graceful cormorant (above) and stately egret (right), perched on lacy cypress trees, would challenge the delicate skill of a Japanese artist

Photos by Moslowski and Goodpaster

In a sadder tone, Dr. Mayfield stated, "Reelfoot Lake has been the problem child of Tennessee."

The problems of the lake have resulted from disagreements over ownership, control, and use. In the late 1800's, when the lake was private property, the West Tennessee Land Company proposed to drain it for a farm. Many local fishers and hunters banded together to resist this. There resulted the dark episode of Tennessee history known as the Night Riders' War. Captain Quentin Rankin, a lawyer for the Land Company, and his partner Colonel R. Z. Taylor, while at Reelfoot on business relating to the drainage project, were kidnapped by the Night Riders. Taylor escaped by driving into the lake and hiding all night behind a log. But Captain Rankin was first hanged and then shot. The Night Riders used ball bearings from bicycle wheels in their shotguns. Eight were brought to trial for the lynching, but none was ever convicted.

Modern management

Today, Reelfoot Lake and about 6000 acres of its shores belong to the state and are under the custodianship of the Tennessee State Game and Fish Commission. The Reelfoot Lake State Game and Fish Preserve was established in 1925. The state has spent close to one million dollars on various improvements, such as all-weather roads to Reelfoot Lake, drainage channels, and a spillway to regulate the water level.

In 1925, when the Tennessee Academy of Science proposed a Reelfoot Lake Biological Station, the natural significance of the lake and the importance of conserving it were underscored. The aim of the Academy of Science was to "preserve it as Nature has made it, to watch more closely the actions and habits of its creatures, to read more deeply into the mysteries of life itself." Supported by a small appropriation from the Tennessee legislature, the station has for 20 years provided research opportunities for scholars. More than 100 articles on the plant and animal life of Reelfoot Lake have emanated from the station, on subjects ranging from dragonflies to two-headed turtles. These articles have won for Reelfoot Lake wide recognition as a naturalist's paradise.

Another important development was the entry of the U. S. Fish and Wildlife Service into the area. The Service has leased about one-third of the lake. Game law enforcement and the cause of conservation have greatly benefited from this.

What there has been to conserve through wise use at Reelfoot Lake can be indicated by a few examples. The local hunting and fishing business has been estimated at $500,000 annually. Before strict supervision, commercial sales of fish were said to have averaged 2,000 pounds a day, sometimes 5,000 pounds; turtles were shipped out at the rate of five tons a week; swans went to Memphis in boxcar lots. In the old days, one tireless hunter is reputed to have killed 5,000 ducks in one year for sale at a quarter a head. Clearly, there is much in the earthquake to be exploited.

There are largemouth bass, bream, crappie, catfish, bluegill, and carp. Waterfowl abound in great variety, including teal, redheads, scaup, mallards, geese, swans, and wood ducks. In years past, telegrams have been dispatched to half a dozen states when a flight of ducks or geese arrived, followed by a mad rush of hunters. At times, some say, the volleys from the shotguns made Reelfoot Lake sound like the Western Front.

Reelfoot Lake is an area of rotten snags of black walnut, gum, oak, willow, and cypress. The surface of the water is dotted with water lilies and with thousands of cypress stumps. Bordering are dense growths of saw grass, mulefoot, smartweed, and wild rice. The plants provide food for waterfowl and breeding places for fish.

Nesting in tall cypress trees are the bald eagles, who live off the swamp rabbits and fish. The smaller osprey, or fish hawk, does much of the eagle's fishing. The larger bird makes passes at the osprey until it drops the fish it has caught. Then, like a bullet, the eagle catches the fish as the osprey releases it, and has a banquet.

In the deepest parts of the darkest swamps reside the alligator terrapins. Their heads are as big as a ten-year-old boy's. Their powerful jaws can shear off a man's finger.

"Catfish justice"

Irvin S. Cobb, who knew Reelfoot Lake well, told a story about a colored man who made friends with one of the huge catfish (up to 200 pounds) that once were found in Reelfoot Lake. Old "Fishhead," as the man was called, was ambushed one night by two Reelfoot men. Next morning, their overturned boat was found along with their bodies. The killers had been horribly chewed, as if by some tremendous fish—perhaps the friend of old "Fishhead."

But the monster catfish are gone. Some say they all escaped to the Mississippi by the spillway at the south end of the lake; others say they were "fished to death." The females often contained 30 pounds of eggs, which were removed and sold to eastern markets at a dollar a pound. Swank restaurants then served the eggs as Russian caviar.

The lavishness of nature has produced "Cranetown," extolled by Roger Tory Peterson as one of the finest heron rookeries in the world. Here, on a 13-acre marshy region, cormorants, herons, and American egrets nest by the thousands. At dusk as many as 100 black vultures roost at Cranetown. There are so many herons and cormorants that during the night, many nestlings will fall to the ground, and all the vultures have to do is wait. By about August 15th, however, the herons and egrets have all left the lake.

▼ An American egret, fully plumed, stands protectively over its young

▲ A cormorant tenement in Cranet
These abundant fish-eaters nest in a

The "lake people" of Reelfoot have developed a distinctive Bayou type of culture. Many, to be sure, migrated to outside jobs during the war, and modern communications

Photos by Maslowski and Goodpaster

y on the western shore of the lake,
g their quarters with egrets and herons

▲ Two black vultures hold a grim death watch at Cranetown, waiting for a young cormorant or heron to fall from its nest

have broken down their isolation. But they are still a colorful group. A typical example of their adaptation is a canoelike boat that is equipped with reverse-action oarlocks so "a man can see whereall he's going." With these strange, jointed contraptions you sit facing ahead, but when you pull on the oars, instead of going backward, you go forward. It's necessary to see ahead so as to avoid hitting the stumps that dot the water.

The lake people are commercial fishermen, hunters, turtle trappers, and guides. One Reelfoot Lake resident has a sign in front of his house: "Carlyle Powell, Shipper of Fine Racing Turtles." Turtle trapping at times brings $15 a day. A guide asks and gets $8 a day. The best price for fish is maybe a quarter a pound, but often it is only a dime. In the days when anything went, some fishermen gigged up to 1000 pounds of fish a day, but now the law prohibits gigging, along with wire nets and the sale of game fish. Seines never were practical; there are too many stumps. The fishing business is good; there are at least nineteen docks and camps that sell tackle to out-of-state sportsmen.

Vanishing folklore

Folks living for generations around the lake, in places like Samburg and Walnut Log, take its wonders without great excitement. They do have a voluminous lore about the lake, but it takes some coaxing to get these suspicious souls to talk. Usually, when they do, it's of such things as the evil spells that the poisonous cottonmouth moccasin can cast over a person. Or they may fuss about the cormorants and the way they drive fish. These birds get together and thresh up the water with their wings so as to catch the fish better. It's too much competition for the lake people.

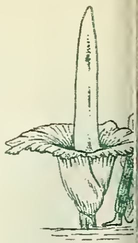
Before too long, the natural customs and beliefs of these people should be studied, because their lore will disappear and then be recast for the gullible tourist who expects his money's worth in weird mannerisms and semi-voodoo.

Reelfoot Lake seems to be silting up, as is natural with lakes. The state recently removed the isthmus at Nix Towhead by dynamite. But the cut grass, willow, and lily communities work tirelessly. And erosion from the watershed brings the earth in. Inevitably, some of it stays.

Reelfoot Lake gives opportunity as the Academy of Science intended, to "read more deeply into the mysteries of life." The eagle forces the osprey to work for him. The birds are attracted because of the lake's location on the most widely used flyway. They fertilize the lake and cause plankton to grow. Rough fish eat the plankton, and game fish eat the rough fish. Man comes out the winner, not always aware of the intense struggle for life that goes on about him.

Reelfoot is indeed a strange surprise for the traveler in what he may have thought was a peaceful and uneventful part of our country—a concentration of marvels produced by a disaster that created more than it destroyed.

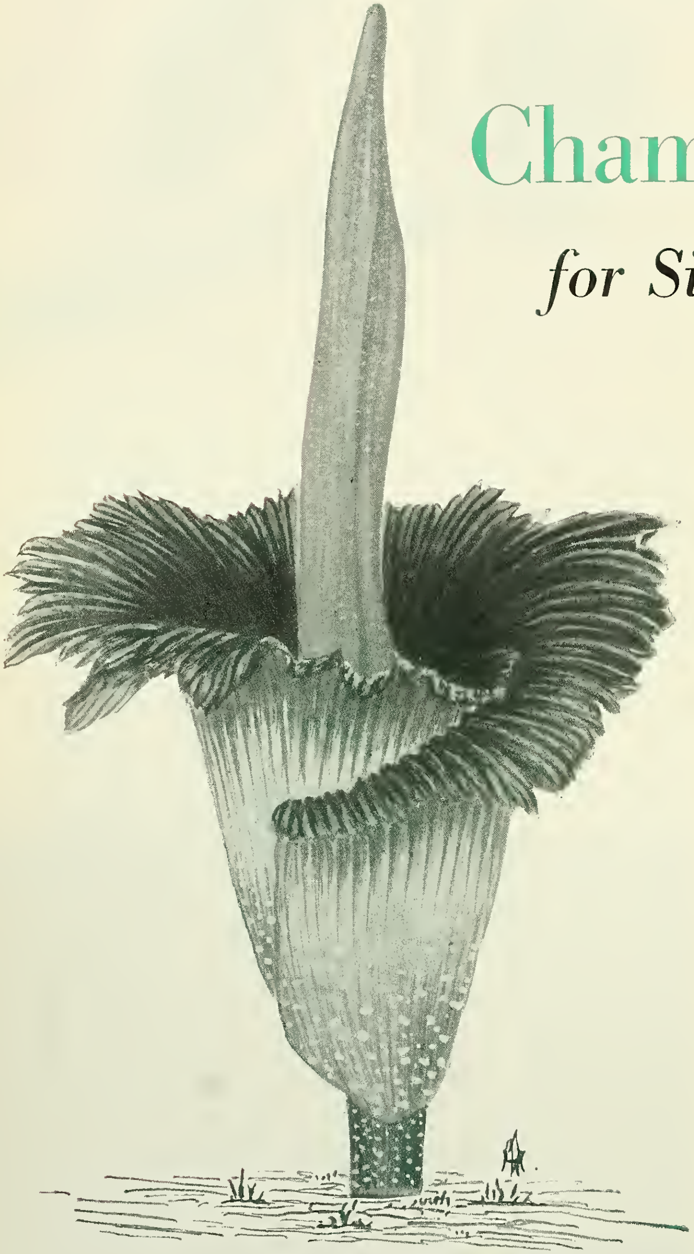
This tropical plant, related to our calla lily and jack-in-the-pulpit, holds the record for size and sickening odor



▲ MAN IS A DW
side *Amorpho*

Champion for Size and Smell

By S. M. LATIF



▲ "BIG STINKER." A nauseating plant like this one can't help but bring forth boisterous humor, even among scientists

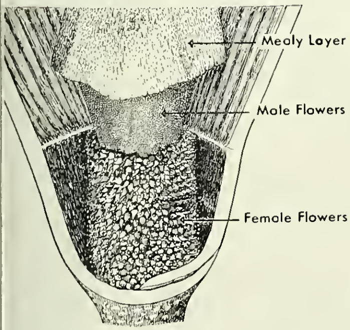
ENORMOUS size and unpleasant smell are combined in several plants belonging to the genus *Amorphophallus*, but the largest is *A. titanum*, which reaches a height of six to eight feet. The color is dirty white and yellow, mixed with purple. The central spike, or spadix, bears many small flowers toward the bottom, and the male and female flowers are restricted to special areas, as shown in the drawing.

It is the upper end of the central spike that gives off the smell. Far from flowerlike, the odor resembles that of rotting meat or fish. The plant is sometimes called the corpse-flower. The power and penetration of the odor is said to be so great that it has caused people to faint, but this may be an overstatement. Sometimes the smell seems to disappear, permitting people to come near and inspect the plant; then a "cloud" of the nauseous odor will issue from the plant, and everyone with a delicate nose flees.

The smell lures the carrion beetles, which find the place ideal for depositing their eggs. Thus they incidentally fertilize the flowers and enable the plant to reproduce. Climbing over the edge of the funnel-shaped "cauldron," the carrion beetles slide down a mealy layer on the floral envelope and plunge into the depths, from which they cannot climb out without difficulty. In their struggles, they become covered with pollen.

After pollinization, the plant begins to fold up, and the beetle may then escape through a special arrangement in the inflorescence and perchance perform his service in another corpse-flower. Some species are fertilized by very small beetles and retain them for several days. The insect may find an edible layer at the bottom and thus be provided with delicious food during its sojourn. When this layer rots, the pollen may fall upon the beetle and be carried by it on its search for another flower.

At least one species *(Amorphophallus variabilis)*, which is very common in Java, is a source of food. The tubers are eaten during the dry monsoon when other foods are scarce. The tuber is grated, mashed, and wrapped up in a banana leaf and roasted. Elsewhere, it is considered inedible; yet the green parts and the ripe fruits are cooked with vegetables in Jakarta, which is also in Java. Other species of this remarkable plant are reported to be used in certain localities during times of scarcity, though not generally included in the diet. Needless to say, however, these astonishing plants are best known for their size and smell.



'LOWERS are deep inside the "cauldron," ie base of the central spike. A corpse-like ll lures carrion beetles, who slide down steep slope of the floral envelope, be- e temporarily entrapped, and pollinate plant in their struggles to escape

Lisa was found on the road 2 years ago

"Little Lisa, now 8½, was found on a road in Austria two years ago. She was wandering, lost and helpless, her mother having just died in giving birth to her 4th. child. There was simply no one to look after the children."—From a report by an SCF Field Representative, Austria.

Lisa's mother had been devoted to her children.

Although she was busy from morning until evening, she was never too busy or too tired to give them all the love and affection they needed. For Lisa, her mother's death meant the loss of the only security she knew. In a country where jobs are scarce, the father goes from village to village trying to find employment. Now Lisa lives with the Weber family. They are fond of the good natured, affectionate little girl who helps in the house and tries hard to make herself useful. However, the Webers, like many of their neighbors, are extremely poor and they receive no child allowance for her. Lisa is growing rapidly, and needs food and clothes which they cannot provide. Lisa may lose this home, too, unless someone helps.

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THEY BUST AVALANCHES WIDE OPEN

continued from page 71

up when stubborn snow requires a second run. The snow starts sliding just as they enter the area and quickly engulfs them. They can't do much to help themselves then.

"You can't stop an avalanche. You can't outrun it," Monty points out. "In the Alps they've been clocked at more than 100 miles an hour. It would take a lot of wax on any man's skis to beat a mass of snow and ice going that fast!"

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Alexander Cushing is one of the few men to win a race with an avalanche. It happened at Aspen, Colorado, in 1948. He, Percy Rideout, and Alexander McFadden were sweeping down a steep slope into a shallow trough. Rideout, first, ended halfway up the opposite slope. McFadden, second, stopped at the bottom. Cushing was halfway down when he heard the awful hissing sound of hundreds of tons of snow let loose behind him. Terrified, he raced ahead of the avalanche and was saved only by gaining some distance up the opposite slope. Even then he barely won . . . since he was caught and partly buried. He was lucky. His friend McFadden never had a chance. He was carried down the valley by the avalanche and smothered to death.

A person should do what he can for himself if caught by an avalanche—and it is precious little.

"Riding it out is like being tumbled in the surf," Monty says, speaking from experience. "You come to the surface, then get sucked under again. You can't tell which end is up. The mass of snow and ice seems alive. When it slows down it closes in on you, and crushes you with a great suffocating weight."

Since there is a wavelike action to avalanches, a heave will sometimes help bring you to the surface. Once Monty did that and the avalanche spit him out. Another time a heave at the right instant enabled him to stick his head out of the snow. If a man is buried when the slide stops, a big heave at the last moment will give him breathing room. A mask of ice will form around his face soon enough, and cut off his air supply—so this last heave is important. When a person is buried, the Snow Rangers figure they have about two hours to get him out alive. After that his chances of surviving dwindle rapidly. Very few persons have been buried in the snow 10 or 12 hours and lived to tell about it. The record is 72 hours, but that bordered on the miraculous.

Combatting avalanches isn't all blood and thunder. Behind the spectacular is the studying. Snow Rangers attend avalanche schools at the various observation stations. Training includes simulated rescues, actual blasting and skiing down a slope, plus long classroom sessions in avalanche control, forecasting, first aid, chair lift and rope tow inspection, and safety practices in ski mountaineering. A person just can't guess when dealing with a great natural force like an avalanche.

Despite the fact that avalanche study has been systematized, occasional misjudgments are made even by experts. Monty admits that he probably pulled the biggest boner of all, proving that no man is infallible.

"Before my partner and I left the avalanche observation station I unwisely opened the ski area," Monty recalls. "I had been fooled by general snow conditions. It wasn't until I started test-skiing that I realized restrictions were necessary. I was hurrying down the mountain to close the area when the slide caught me."

Monty was packed in solid, with only his head exposed. Luckily a skiier spotted him—or rather his head. The skier offered to dig him out, but the veteran ranger told him to see that the lifts were shut down, and the area closed, and then to come back with men and shovels. Monty remained in uncomfortable cold storage until all this was done. Minutes after he was dug out, three slides tumbled down the slopes.

Avalanche study is never-ending, but as Frank Foto, Snow Ranger at Stevens Pass, Washington, said not long ago, "We have been able to reduce the hazard to manageable levels. We can pinpoint our shots, and cut a potentially aggressive avalanche down to size, piecemeal, the way we want, or we can bust him wide open!"

LETTERS

continued from page 57

fortunately the largest tree—the one 47 feet in circumference—was still unharmed the last time I saw it.

Why must we have folk who are determined to destroy things that cannot be re-created? Nell Murbarger
Costa Mesa, Calif.

Adam's "Apple"

Sirs:

With reference to Adam and Eve and the Apple, I find no specific mention of the apple (as distinct from "the fruit," "the tree of life," etc.) in the King James Version, though you suggest in your article that the confusion between the apple and the apricot may first have occurred there. Alice Brown
Chicago, Ill.

Miss Brown is correct. The forbidden fruit is not identified as the apple in the King James Version, though it is to that version that we owe much of the confusion regarding the plants of the Bible that has misled writers from that day to this. Harold N. Moldenke's book *Plants of the Bible* contains much carefully annotated evidence on these questions. He regards the appearance of the "apple" in the famous story of the so-called "Fall of Man" in the Garden of Eden as an example of poetic license. All of the references to "apples" in the Bible are the result of misinterpretation, not only according to Dr. Moldenke but to practically all other scientifically trained students of the Bible. Most botanists are agreed that the common apple is not a native of Palestine but a comparatively recent introduction there. It appears likely that the fruit referred to was the apricot. But Renaissance artists, such as Titian, Rubens, and Tintoretto, painting at the time of the King James Version or shortly before it, popularized the apple as the "Tree of Knowledge" in the Garden of Eden.—Ed.

Sirs:

. . . I appreciate immensely your articles on nature and its beauty. Articles like "Sulphur for Our Way of Life," "Useful Drugs From Toad Venom," and associated scientific subjects are extremely interesting, but I think your paramount achievements are in dealing with the world of nature.

How about an article on the national refuges for our animal friends? Information on some of our nearly extinct birds would probably be appreciated by your readers. Gus Napier
Lumber City, Ga.

Sirs:

Enjoyed very much the article entitled "Wild Dog of Africa" in your December issue. Gerald C. Robechaud
Pacific Palisades,
California

From a Physician:

Yours is a waiting room magazine, but we have 25% loss. Patients "borrow" them, without saying anything.

From a Geologist:

The professional journals could take a lesson from Natural History.

From a Housewife:

After being read in our immediate family, Natural History Magazine is loaned to two other families; it then goes to a Junior High School teacher for her reading table, where 25 to 30 pupils have access to it.

From a Salesman:

Natural History is the finest magazine I have ever subscribed to.

Just Buttons

By Dorothy D. Freas

REAL pearls may be important to many women, but the sartorial perfection of every man depends at least partly on the row of pearl buttons down his shirt front. These six buttons are a tiny part of a $10,000,000 industry in the United States, which in turn, depends entirely on the lowly fresh-water mussel.

Asia and Europe provide some shells for the button industry, but our own Mississippi Valley is the Kimberley of pearl button manufacturers. Iowa, Wisconsin, Arkansas, Tennessee, and Kentucky are the states where button making is a big industry.

About 1890, a German immigrant devised a foot-powered lathe to cut buttons from shells. Later, after selling some handmade ones, he rigged up a set of hooks for gathering shellfish on the river bottom. The pearl buttons he made by cleaning and drilling the shells were rather crude, but they found ready sale, especially as their price was half that of the imported ones.

Until this time, fresh-water shells had not been used for button-making. Since mussels were found in huge quantities and the taking of them was not restricted, there was only one problem, that of designing a machine that would cut the blanks. This was soon achieved. The new machine stamped out the disks and drilled the holes in them much more rapidly than had been possible before.

One modern firm uses a steam dredge to get the shells and cuts the blanks from them with a tubular saw. The disks are ground smooth and divided as to thickness. Drilling makes the "sewing holes," and sometimes a little pattern is cut into the button. Finally, a mixture of acid, abrasive, and powdered wood is tumbled about with the buttons, polishing them to the last stage of completion, so that when a card of pearl buttons is laid beside the original shell, there is very little similarity left.

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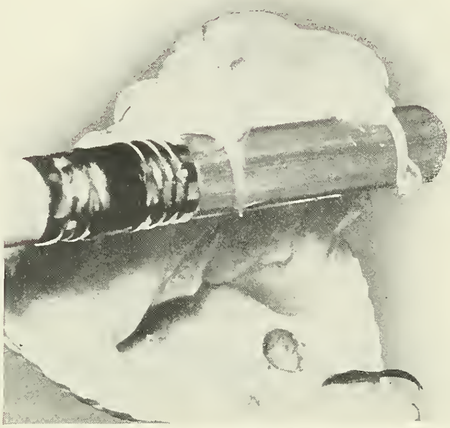

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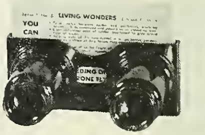

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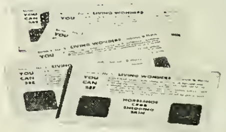

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continued from page 63

water-soaked plumage in a manner suggestive of rudimentary lactation.

Dr. Rand has hewn to the cautious, behavioristic line in interpreting these and a hundred other curious phenomena. A list of references documents every statement not based upon original observation. Only rarely has the author lapsed into a clause with a suspicion of anthropomorphism.

In his discussion of "powder down," the talc-like bloom, which suffuses over the feathers of some hawks and herons, he might well have included the startling discovery of Lord William Percy, who found that the bittern has four "powder puffs" for "dry-shampooing" its feathers. The bittern uses these permanently-fixed puffs, which come already equipped with powder, in combination with its natural oils and a "comb," located below the claw of the middle toe, to refresh its plumage after a meal of slimy eels. (See NATURAL HISTORY, Nov.-Dec., 1933.)

R. C. M.

EXPLORING MARS

- - - - - - by Robert S. Richardson

McGraw-Hill Book Company, $4.00
261 pp., 28 illus.

THE close approach of Mars in 1954 attracted considerable interest. Even more should be aroused when it returns in 1956. Dr. Richardson's book seems in a good position to capitalize on this interest.

Exploring Mars is relatively light reading about planetary astronomy, including some of its history and moments from the lives of its great contributors. The title is somewhat misleading, for the book does not stop with Mars. There are also chapters on Mercury, Venus, the asteroids, Pluto, and one on the Giant Planets.

Three chapters about space travel are less welcome, being a rehash of theories and plans that have been amply reported in the past ten years, with some new speculation and imagination added. It is regretted that this topic comes so early in the book; readers may get an entirely erroneous impression of what follows. The seven chapters on Mars, though they are stretched out a bit, together with those on the other planets, could stand by themselves, without the dressing of space travel that someone thought necessary. The author is best appreciated when telling of his science and the people who work in it, with all the appeal of an accomplished storyteller.

A definite attempt is made to exploit the topical interest in Mars, giving directions for finding and observing Mars in 1954 and 1956 and noting the observing program planned for those years. This will tend to date the book rapidly, and has already done so to some extent. Coming when it does, the book may disappoint some readers in failing to report any results of the 1954 observing program.

The illustrations include excellent lunar and planetary photographs from the Mount Wilson and Palomar collections and adequate line drawings to illustrate the chapters. Two star maps, black-on-white, could have been improved upon.

THOMAS D. NICHOLSON

JUNGLE QUEST

- - - - - - - by Edward Weyer, Jr.

Harper & Brothers, $3.50
210 pp., 43 illus.

DR. WEYER has written a highly readable, thoughtful account of an unusual, one-man expedition into the Matto Grosso country of Brazil. He writes how he, an Arctic man, made this trip to one of the remotest spots on earth solely to interview Orlando Villas Boas, a truly remarkable Brazilian administrator of Indian affairs. The results of the interview seem inconclusive. This reviewer suspects that this purpose was incidental, stressed here to provide plot and climax to a popular account.

He visited the wild Chavantes, some of whom have never before seen a white man, and spent some little time with the Camayurás, who, though less wild, have still killed a few white men. His description of these people is fascinating. In tracing the Asiatic origin of certain ancient cultural elements among these tribes, he sometimes fails to give sufficient emphasis to influences that probably resulted from contact with other Indians. However, his observations on untouched primitives are enlightening and thoughtful. Here is an anthropologist who has an active social conscience as well as social curiosity, and to whom the subjects of his study are truly fellow-humans.

Early in the book he says that he expected neither hair-raising adventures nor severe hardships; later he affiliates himself with those explorers who believe "that adventures are a sign of incompetence." The integrity that these remarks bespeak shows all through the work. Altogether, this is a delightful account of the kind of quiet, unassuming, genuine exploration by which science grows.

OLIVER LA FARGE

K2—THE SAVAGE MOUNTAIN

- - - by Charles S. Houston, M.D. and Robert H. Bates

McGraw-Hill Book Company, $6.00
334 pp., 27 bl. and wh. photos, 9 color

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by ROBERT S. RICHARDSON

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This book tells about a well-organized attempt to climb the second highest mountain in the world, K2, 28,250 feet above sea level and less than 800 feet lower than Everest. The name K2 signifies that it is the second high peak in the Karakoram Range to be given a provisional designation by the Survey of India. The attempt failed when the climbing party had reached Camp VIII at 25,500 feet, and needed only three days of good weather for the last dash; they then had the heart-breaking experience of a nine-day blizzard with snow and winds up to 80 miles an hour. To add to the crisis, one of the climbers became critically ill and needed to be taken down to the base camp at the earliest possible moment if his life were to be saved. Tragedy overtook the ill-fated party when this was attempted.

The story is told by two of the active climbers, is very well planned, and covers the expedition from start to finish. A series of appendixes list food, equipment, transport, etc., and the reader has a very good idea of the complex undertaking back ol the exciting narrative.

The lay-out of the printed page is good, the pictures are fine, and to anyone who would like to share the hazards of *The Savage Mountain* by proxy this book is recommended.

Harold E. Anthony

A HISTORY OF BIRDS

- - - - - - - - - - by James Fisher

Houghton Mifflin Company, $3.75
205 pages

THIS is the third book to be published in the past year in which the name of James Fisher appears as author or co-author. A recent investigator concluded that the most prolific writers among scientists are also, with a few glaring exceptions, among the more competent. Fisher seems to support this point of view; at any rate, in *A History of Birds* he has skillfully condensed a vast amount of information and enlivened it with pithy comments and interpretations.

Fisher, in 1939, wrote his first book, *Birds as Animals;* the present volume grew out of an attempt to revise this earlier one. It proved necessary not merely to completely rewrite the book but to split it into two volumes, of which this is the first! Specifically, the present book includes a history of ornithology; the evolution, classification, and distribution of birds; and the dynamics of bird populations—cycles, extinctions, introductions by man, methods of counting bird species, and the effects of changes in climate. (The migrations and habits of birds will form the subject of the later work.) Although fully annotated and intended for university reference, *A History of Birds* is easily comprehended and everyone interested in birds will find it useful. The appeal is not only to the ornithologist but to those interested in books about birds; in Audubon, Wilson, Catesby, and other pioneer American naturalists; and in the decline of many spectacular birds and the efforts being made to conserve them. Highly recommended!

Dean Amadon

WAYS OF MANKIND

Thirteen Dramas of Peoples of the World and How They Live

- - by Lister Sinclair, Len Peterson
Eugene S. Hallman
George Salverson

Edited with commentary
by Walter Goldschmidt

Illustrated by Arminta Neal

Beacon Press, $3.75
212 pp., 30 line drawings

WAYS OF MANKIND is a most unusual treatment of an unusual subject. It consists of thirteen annotated radio scripts in the field of social anthropology dealing with such diverse aspects of culture and society as technology, the family, values, religion, the arts, and a number of others.

These experimental scripts — designed to popularize some basic concepts of social anthropology—came into being as a result of action taken by the National Association of Educational Broadcasters in order to improve the quality of educational radio programs. The broadcasts were

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highly successful, and the credit for their excellence is due equally to anthropologist Goldschmidt and to the writers and producers of the Canadian Broadcasting Corporation.

Save for the music, which added enormously to the effectiveness of the programs on the air, these scripts lose little in the reading. In fact, the half-hour dramas have been so tightly written—so as to meet the standards of both anthropologist and script writer—that it is an advantage to be able to read them at leisure. In addition to the original scripts, the editor has written a series of brief transitional sections that serve to draw together the individual pieces into a more coherent whole.

This collection, therefore, is a presentation in dramatic form of some of the key principles of social anthropology, illustrated from several different cultures, primitive and civilized, ancient and modern. In each script, the central idea or principle is emphasized, rather than the cultural content.

While I found all of the dramas entertaining and informative, some of them struck me as brilliant. Certainly "The Case of the Sea-Lion Flippers," illustrating ethics, and "A Word in Your Ear," illustrating the role of language in culture, could hardly be improved, either as anthropology or as entertainment.

HARRY TSCHOPIK, JR.

THE BAFUT BEAGLES

- - - - - - - by Gerald M. Durrell

Viking Press, $3.75
238 pp., 22 drawings

READERS will be charmed with Gerald Durrell's account of his adventures, while collecting live animals in the grasslands and forests of West Africa. For his expedition Durrell employed a crew of four native hunters and a pack of six thin, ungainly mongrels with their owners. He called this untidy ensemble of men and dogs the Bafut Beagles. The reader enters a green world of adventure and high humor, a wonderland where hairy frogs haunt the cool streams and tiny flying mice spend the day sleeping in huge forest trees. We learn that it was to take back such strange creatures as these that the author of this book set his aspirations. He displays a remarkable sensibility in his descriptions of jungle life. Of the galagos, a genus of lemurs which he describes as like something out of a fairy tale, he writes: "I followed the pointing finger, and for a moment I could see nothing but a compressed net of branches. Then something moved and I saw the animal we had been awaiting . . .

"He came drifting through the tangled branches with all the gentle, airy grace of a piece of thistledown . . . He sat on a branch, twittering vaguely to himself, for about a minute; then an astonishing thing happened. Quite suddenly the trees were full of galagos, galagos of every age and size, ranging from ones little bigger than a walnut to fully adult ones that could have been quite comfortable in an ordinary drinking glass. They jumped from branch to branch grasping the leaves and twigs with their large thin hands, twittering softly and gazing round them with wide-eyed innocence of a troupe of cherubim."

I can recommend this book as pleasant and entertaining to everyone, even to those who are not especially interested in wildlife.

Gerald M. Durrell was born in India; he was educated in France, Italy, Switzerland, and Greece, specializing in zoology. In 1945, he went to Whipsnade Park Zoo in England as a student-keeper and since has made several major collecting trips to West Africa and British Guiana.

GEORGE G. GOODWIN

MARGINS OF THE SEA

- - - - - - - - by Maurice Burton

Harper Brothers, $3.00
212 pp., 33 illus.

TO THE many laymen who have drawn inspiration from Rachel Carson's *The Sea Around Us*, this book should prove an interesting sequel. For, while Miss Carson has stressed the fitness of the ocean as the cradle of life, Dr. Burton analyzes the fitness potential of the various types of marine animals for adaptation to the more complex and hazardous land environment.

Thus, pursuant with this theme, he presents the tidal beaches as a perennial battleground in which all aspirants to a life on land must either win or lose eventually. In illustrating this point, he remarks that while the land vertebrates and plants, and also insects and spiders, were early winners, many other living forms are still in the fight. Moreover, as he ably points out, the victory is not complete even for the winners, since not a few have returned to sea, a still larger number have accepted fresh water as a compromise, and all of them in one way or another have carried part of the sea with them when they invaded the land.

Dr. Burton is a facile and entertaining writer, and the hard biological facts he presents are enlivened by many personal reminiscences. While he combines the caution of the scientist with the speculations of the mystic, he is careful not to allow the one to flow over into the other. Over the question of vitalism versus mechanism, he is apparently noncommittal. His black and white drawings more than adequately illustrate the specific points he brings out.

G. H. CHILDS

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The Screen Authoritative comments on films in the field of nature, geography, and exploration

Edited by Elizabeth Downes

20,000 Leagues Under the Sea

Reviewed by James W. Atz

When Jules Verne's book by this name was written, the life within the ocean was largely unexplored. The beauty and wonder of the hunting episode in the "submarine forest of the Island of Crespo" and the underwater burial scene are bound to start a naturalist speculating on what would have resulted if the producers had availed themselves of the tremendous advances in knowledge of marine life that have been made since the 1860's. Wonderful entertainment.

Walt Disney, Technicolor, CinemaScope, and Stereophonic Sound
Running time: 123 min.

Vera Cruz

Reviewed by Gordon Ekholm

Good Mexican scenery forms the background for this story, which is built around the dramatic period of Maximilian's brief reign as Emperor. Otherwise this film is just a rather flamboyant "Western."

United Artists, Technicolor
Running time: 94 min.

Underwater

"Underwater" is an adventure story built around a search for treasure, buried in a sunken ship. The technique of skin diving with aqualungs is demonstrated, but the viewer sees little undersea life. The underwater scenes are largely studio made.

R.K.O., Technicolor
Running time: 99 min.

Films previously reviewed

Documentary and Grade A	**What the Experts Said**
Hunters of the Deep Undersea life filmed in color	An excellent opportunity to become acquainted with the ocean's depths
The Purple Plain A vivid portrayal of man's struggle against the elements	A highly recommended film, shot in the Burmese jungle
The Vanishing Prairie A Disney film dealing with the vanishing wildlife of the American prairie	Exciting, instructive, and highly entertaining
Down the Alphabet	
Quest for the Lost City Adventures of the Lambs during their quest to discover a lost Maya city	Incredibly contrived piece of nonsense
Sitting Bull Story of the Sioux Indian leader	Sitting Bull, General Custer, and history in general are massacred in heap big horse opera
West of Zanzibar Ivory poaching racket in Africa	Filmed on location, shots of big game, fishing scenes

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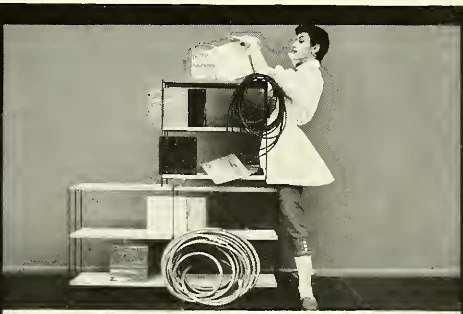

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BRAHMS

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Utrecht Symphony, Paul Hupperts, Conducting

MOZART

Piano Concerto in E Flat, K 107
Artur Balsam, piano, Winterthur Symphony Orch.,
Otto Ackermann, Conducting

BACH

Toccata and Fugue in D Minor,
Alexander Schreiner at the Organ of the Tabernacle
Salt Lake City

WAGNER

Die Meistersinger, Prelude, Act 1
Zurich Tonhalle Orch., Otto Ackermann, Conducting

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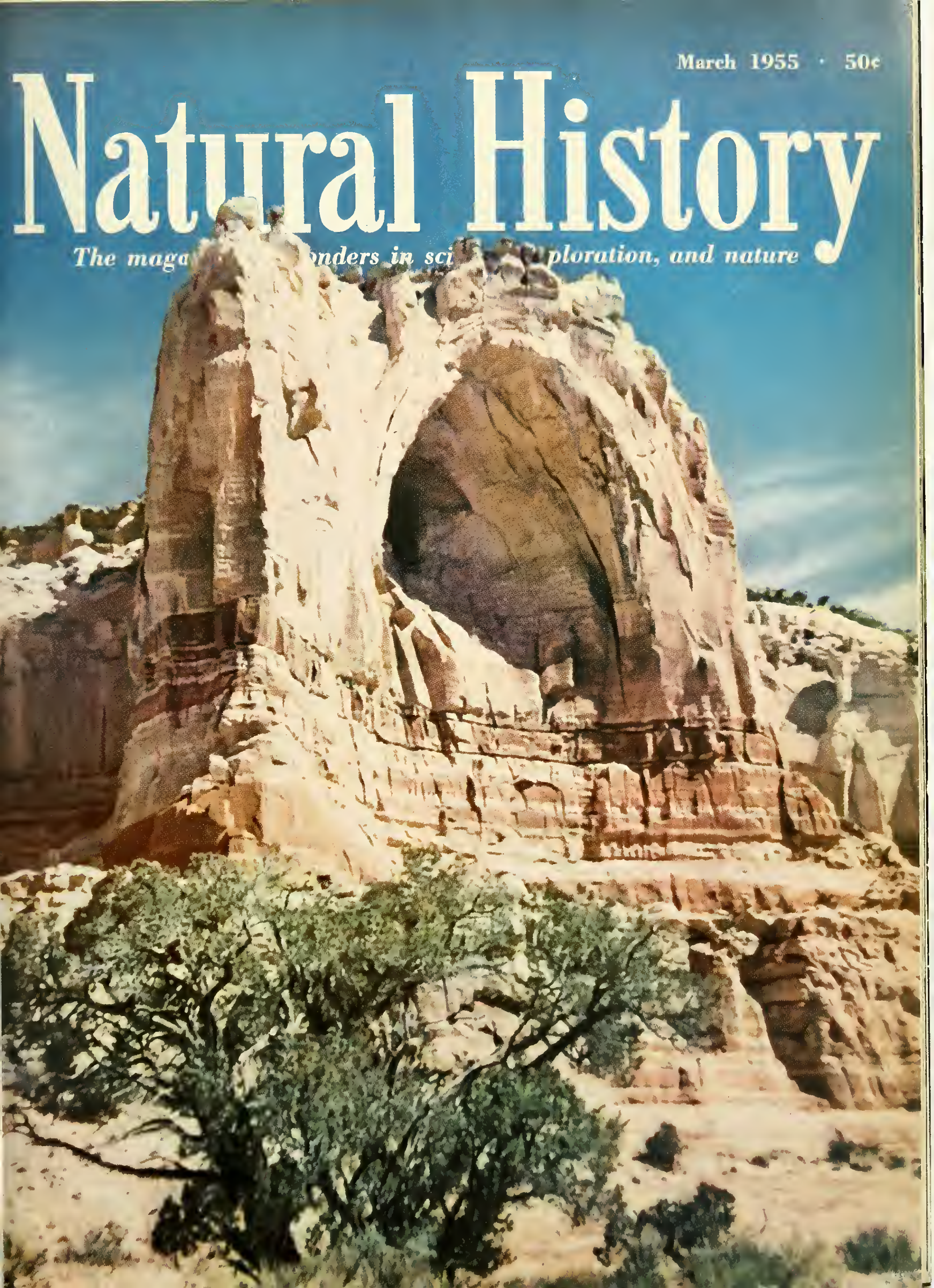

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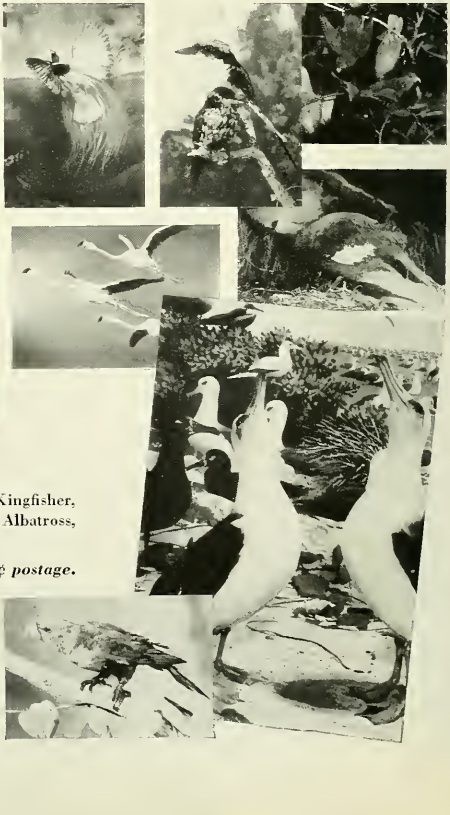

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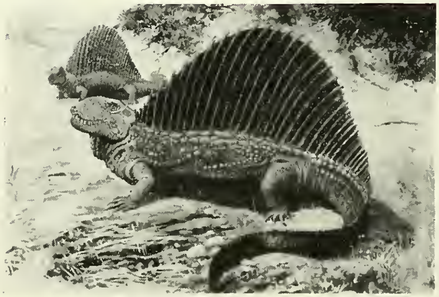

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March, 1955 Volume LXIV, No. 3

Parabola in Stone ... Cover Design
From a color transparency by William C. Miller

Your New Books ... 116

Twelve Years In A "Green Heaven"
Arthur F. Joy and Richard E. Schultes 120
Did you ever wonder what it's like to be a plant-explorer in the tropics? Here are the reminiscences of a botanist who has just returned from more than a decade in the jungles of Colombia and Brazil

Is the Giraffe Mute? ... Jane Stanton 128
The author answers, "No," and describes the extraordinary circumstances under which she heard a giraffe "speak"

Secrets of the Pearl ... R. Tucker Abbott 130
Beautiful women of all nations and all eras have regarded pearls as a symbol of elegance, yet few people know the fascinating details of their growth and variety

Patagonian Penguins ... Robert Cushman Murphy 134
The "strange geese" we now call penguins were first seen by Europeans in this region

We Explored White Mesa ... William C. Miller 140
In a day when unexplored territory is thought to lie only at the uttermost ends of the earth, it is exciting to find an untouched gem so close to home

Grazers of the Sea ... 147
Though seacows are gross, sluggish, and clumsy, some men called them lovely

Guided Tours Now Come in Boxes ... William A. Burns 150
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Fashions are being influenced by a distinctive handicraft that has grown up in the land of the lei

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Ancient "sea-creepers," new to science, found in their graves far from the coast

A Beetle That Somersaults ... Ross E. Hutchins 160
With a built-in inverter, the click beetle is never on its back for long

Letters ... 166

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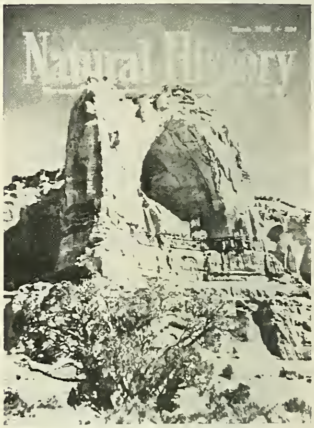

THE COVER THIS MONTH

While exploring White Mesa in northern Arizona, William C. Miller came upon this remarkable formation, as told in an article beginning on page 140 of this issue. The men were quite close before they saw it, towering above them like a gigantic band shell. It is possibly the most symmetrical formation of its kind ever reported. Yet the author finds no evidence of its previously having been officially reported or photographed. Even the trader at the near-by post of Kaibito was unaware of its existence.

The formation towers over one of the canyons of White Mesa, which is located in the Navajo Indian Reservation, about 50 miles south of Rainbow Bridge. Because of the magnificent sweep of its parabolic curve and the massive spire at one side, the travelers felt that the name "Cathedral Arch" was appropriate.

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3,000 square miles of wonderland ... and it belongs to you

The guide books tell you that Yellowstone National Park has more geysers than the rest of the world combined. They tell how Old Faithful performs every 66 minutes, how the Yellowstone gorge riots with color as the river tumbles over falls twice as high as Niagara—how you can see elk, moose, buffalo, bear and all the rest as the first white man saw them in 1810.

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A Salute to the National Parks Association

Sinclair salutes the National Parks Association for its tireless work in helping to preserve the primeval character of our great national parks.

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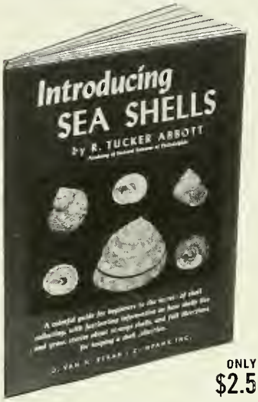

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BIRDS OF THE OCEAN

- - - - - - - - - - - by W. B. Alexander

Putnam, $7.50
306 pp., 88 illus.

NORTH AMERICA, Europe, and Australia now boast handbooks of more or less continental scope that enable a diligent observer to name almost any bird of which he can obtain a satisfactory glimpse. The same is true of many lesser regions, such as countries, states, or non-political geographic areas. The oceans, which cover 71% of the surface of the globe, were long without such a convenient *vade mecus*, but, in 1928, Mr. W. B. Alexander, of Oxford University, made up for the deficiency by bringing out his *Birds of the Ocean.* A large part of his research and preparation of the text was undertaken in the American Museum of Natural History which, thanks to the Brewster-Sanford South American Expedition and the great Whitney South Sea Expedition, has a peerless collection of oceanic birds.

The intervening quarter-century has seen great advances in our knowledge of the relationships, distribution, and travels of salt-water species. The time is therefore ripe for the appearance of Mr. Alexander's revised and rewritten edition, which corrects former errors and adds information to bring his work up to date, without radical changes in style or arrangement. The coverage and the order in which the groups are treated are the same in both editions except that an appended and very useful systematic list of all ocean birds has now been brought into a sequence reflecting current opinion. It begins with the penguins and follows through the petrels and their kin, tropic-birds, pelicans, boobies, cormorants, frigate-birds, phalaropes, skuas, gulls, terns, and auks.

No voyager who takes an interest in visible life at sea can afford to be without this book in his kit, because, in virtually every part of the maritime world, ocean birds are by far the most conspicuous creatures—more so than porpoises, seals, fish, or invertebrates.

The introductory text with which Mr. Alexander opens his treatment of each family is interesting and trustworthy, but let it not be forgotten that the prime purpose of his book is to arm a traveler for the *identification* of what he sees. That very fact has led to textual disruptions of normal relationships and to an arbitrary retention of binomial technical names when, in many instances, the term used applies properly to a subspecies rather than a species. An example is that the "Herald Petrel" and the "Trinidad Petrel," two races of one species that would be quite indistinguishable in the field, are presented as distinct species because one of them is found only in the Pacific and the other in the South Atlantic and Indian oceans. The reviewer might also have a bone to pick with his friend the author on the admittedly difficult subject of popular names. "Cape Pigeon" is both a name and a bird known to millions; it is in every way preferable to the book name "Pintado Petrel."

R. C. M.

TIMBER IN YOUR LIFE

- - - - - - - - - - - by Arthur H. Carhart

J. B. Lippincott Company, $4.00
317 pp.

THIS is an interesting discussion of our forest problems. Mr. Carhart writes from a background of long years of intimate association with the national forests and the forest conservation movement. A westerner himself, he has served in recent years as an effective spokesman for that vast majority of westerners who have been as opposed as anyone else to the loudly advanced proposals of a small clique of livestock operators and lumbermen who would like to virtually take over the national forests and public lands.

An excellent series of chapters on the history of forest use and forest conservation provides a valuable perspective for today's controversies over forest conservation. He tells of the forest reserves of the early 1800's and the final capitulation of the Congress in 1851 to the clamor of the "timber thieves" who posed as "poor, oppressed citizens." He points out that this set the stage for the destructive lumbering of the great forests of the Lake States, forests that, if they had been properly managed, could have supported a stable forest economy in what are today the poverty-stricken northern counties.

The Roosevelt-Pinchot era is well covered. The Ballinger-Pinchot affair is presented as basically a fight over a barefaced steal of national forest land, not unlike those that are still going on under the 1872 Mining Law.

The operations of the Forest Service are described in some detail. Enough basic information on ecology and forestry is given to provide the layman with an understanding of the laws of nature that must be complied with in the management of forest land. Throughout the book, Mr. Carhart stresses the fact that our national forests are far more than just "tree farms" or livestock pastures. He points out that the watershed protection value of many Western forests is so vital to the community that any other uses must always be regarded as definitely secondary. He also points out that our national forests are to an increasing degree playgrounds and public hunting grounds for all the people, where they need never fear "No Trespassing" signs.

In his chapter on the "Land Grab Gang," Mr. Carhart tells the full story of the attempt by a small group to get vested rights in national forest grazing, which would virtually hamstring the Forest Service's multiple-use program. He shows how this group, once they could convert their grazing permits into rights, could retire on the differential between the 60¢ per month per head they paid the Forest Service and the $2.00 or more per month per head that other cattlemen are willing to pay for such grazing rights. In very specific terms he spells out some of the sordid details of the tactics this group has been willing to stoop to in the past few years in order to gain their ends. The closing pages deal with the very real problem posed by the fact that on the average over half of the wood in the trees currently being harvested from our forests becomes "waste" and is never put to any useful purpose. This means that a given acreage of forest could produce twice the raw material for industry that it is now producing if the lumber industry could only step up its efficiency to match that of the meatpacking industry.

RICHARD H. POUGH

DANGEROUS RIVER

- - - - - - - - - by R. M. Patterson

William Sloane Associates, $5.00, 314 pp.

THIS is the story, told 25 years after, of two summers and a winter that two young Englishmen spent in a little-known corner of the District of Mackenzie in Canada.

The South Nahanni River is a tributary of the Laird, which in turn flows into the Mackenzie at Fort Simpson. Tales of a fabulous lost mine in Deadman's Valley along the Nahanni lured Patterson into this country in the summer of 1927. He did not find the gold; from his account, it seems that he didn't look very hard. But the beauties of the country and the abundant game caused him to plan to return with his friend, Gordon Matthews.

The following May they descended the Laird with several canoes, loaded with an outfit and an outboard motor that didn't last very long. Tracking the canoes up the rapids of the Nahanni was an almost impossible task, but they finally reached Dead Man's Valley where they built a cabin.

Moose, caribou, Dall's mountain sheep, and fish were plentiful, so food was rarely a problem. Trapping was the principal winter occupation. After Christmas, Matthews made a trip down the frozen rivers to Fort Simpson and was so long in returning that Patterson followed to see what had happened to him. After the spring breakup, Matthews and Patterson sold their outfit and came outside, realizing a nice profit from the fur catch.

This is not an adventure story. A keen observer of people and wildlife has recorded daily events of life in a country where losing a canoe in rapids, or breaking through river ice, is merely a funny story—if you get away to tell it.

JAMES A. FORD

DESIGN OF THE UNIVERSE. The Heavens and the Earth

- - - - - - - - - - - - by Fritz Kahn

Crown Publishers, $5.00, 373 pp.

IN 373 pages Mr. Kahn has both explored the atom and pried into the enigmas of 200-inch telescope space. In between, he has looked into the philosophical development of scientific thinking, the physics of Kepler, Newton, and Einstein, the astronomy of the solar system, stars and radiation, geology, meteorology, and sundry other fields. He has attempted to portray a pattern of relatedness among all these subjects. For the most part he has succeeded, and has done so with language that is interesting, depictive, and occasionally poetic (even overpoetic). The volume is a tribute to the author's vast knowledge in a diversity of subject matter and his ability to cull the underlying precepts from the sometimes tangled agglomeration of detailed and mathematical studies.

The material presented is current. New aspects of radio and observational astronomy are placed in perspective, neither underestimated or overrated. Weather and geology are treated as sciences of change on a rotating and revolving globe in space.

The description of satellites is somewhat unconventional; Mr. Kahn prefers to think of some of the large objects attending the planets as "moons," and the others as "smaller bodies." He defines his distinctions, however, so the nonconformity is permissible. The mean density of the earth he lists as 5.2; most studies place it nearer to 5.5. Also, there is a curious paradox in the use of figures, for theme of the book is integration of the natural sciences at a popular level, whereas the metric system is used throughout. The average American reader is hampered in his attempts to visualize in this system. Several science books have been published recently that utilize the centimeter-gram-second system. The trend is good, and overdue, but out of place in this book.

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The illustrator, Mr. Matthew Kalmenoff, deserves special honors. His art work is refreshingly original and is in keeping with the smooth, descriptive character of the writing. Together, Messrs. Kahn and Kalmenoff have turned out a unique, readable, and impressive volume.

Joseph M. Chamberlain

OUR BEAUTIFUL WESTERN BIRDS

- - - - - - -by Russell T. Congdon

Exposition Press, $9.00, 408 pp., 185 photos, 4 in color

DR. CONGDON, a surgeon residing in the state of Washington, has photographed birds for many years, both in his home state and at other western localities from Hudson Bay to the coast of Texas. This book brings together the results of the pleasant hobby Dr. and Mrs. Congdon have pursued for many years. The Congdons made a number of interesting firsthand observations on their field trips, and these are reported in a distinctly warm and human manner.

This reviewer feels that the text of the book would have been improved with a little more organization. And many of the photographs do not show the sharpness of focus and skilled use of lighting that we have come to expect of late.

Dean Amadon

ROSES

- - - - - by Pierre-Joseph Redouté

British Book Center, $8.50 15 pp., 25 illus.

THIS publication is primarily a folio of superb color plates. Twenty-four plates have been selected from Redonté's great pictorial monograph on the rose, first published in Paris in 1817, as three folio volumes, containing 170 plates and later in two octavo editions (1824-1830).

This selection has been bound into an attractive volume with a brief introduction by Eva Mannering, who made the selection, and with short descriptions of the roses figured. These descriptions, in the forepart of the volume, are in French and are taken from the original edition of *Les Roses* (with some slight abridgements). The French botanist Claude-Antoine Thory was the author of these diagnoses.

The color plates are labeled at the bottom with the Latin name and the French vernacular name. But the fact that French is the vehicle for the written word should not discourage potential owners of this book, for pictures speak a universal language, and a rose by any name is beautiful and satisfying to behold.

Pierre-Joseph Redouté was born in 1759, into a family already noted for artistic competence, and it was only natural that his early years were spent in the study of painting. He loved flowers, and it was fortunate that he received the encouragement in his formative years, which was to produce one of the most illustrious careers in the field of botanical art.

The engraving in this volume is exceptionally fine; the color values are excellent, and it would seem that everything in the original has been faithfully preserved. The artistry is such that one has an illusion of the third dimension. This is a book to have lying about on the table, to pick up at odd moments, and to revel in the beauty it affords.

It is not a compendium of roses grown today, the varieties are not in modern gardens, and the artist is a perfectionist. None of his sprays shows a worm hole or a blemish, but it is nice to know that roses once grew that way!

Harold E. Anthony

FISHES OF THE WESTERN NORTH ATLANTIC

Sawfishes, Guitarfishes, Skates, Rays and Chimaeroids

- - - - - by Henry B. Bigelow and William C. Schroeder

Sears Foundation for Marine Research Yale University, $15.00, Mem. No. 1, pt. 2, xvi + 588 pp., 127 figs, 2 maps

THIS is the second volume of *Fishes of the Western North Atlantic;* Part one was published in 1948 and contained the lancelets, cyclostomes, and sharks. American icthyologists are co-operating in the preparation for the layman and scientist of descriptive accounts of the fishes of the western half of the North Atlantic, including gulfs, seas, and bays, from Hudson Bay southward to the Amazon River.

The previous volume treated 39 genera and 70 species, whereas the present one describes 27 genera and 67 species.

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Part one had 1117 footnotes, whereas Part two has 1388 on 562 pages of text. It is suggested that in future volumes this distraction for the reader could be materially reduced by inserting much of the footnote information in the text. Otherwise, this book is attractive and beautifully prepared.

During the long time that this volume has been in the process of preparation, I have been in touch with the authors, observing their careful methods of study and conservative attitudes on classification and nomenclature. The drawings have been expertly prepared, and conclusions show mature judgment. This volume is not a compilation; instead it represents original obervations and conclusions. The authors should be very happy that laymen and scientists may have full confidence in this valuable and accurately prepared contribution.

Leonard P. Schultz

THE ODYSSEY OF AN ANIMAL COLLECTOR

- - - - - - - - - - by Cecil S. Webb

Longmans, Green and Co., $6.50
368 pp., 31 illus.

CECIL S. WEBB, at present the superintendent of the Dublin Zoo, has spent many years collecting animals for zoological parks and private individuals and in the course of this field work has visited many countries. This book tells, in simple narrative fashion, of the many interesting happenings that took place. Many of the animals he hunted have unusual habits, not generally known, and the remote regions where he sought them have items of interest in their peoples, their topography, climate, et cetera. To a certain extent the reader of this book will make a trip around the world, taking in many of the usual tourist sights, but the journey will be high-lighted by a quest for the unique animal life, which seldom is encountered by the casual traveler.

This is autobiography, and the author tells how his boyhood years awoke an interest in animals and started him on what was to become a life-time career. His early ventures in collecting live animals, transporting them to England, and finding a market were successful, and soon his reputation was such that trip after trip resulted.

Collecting live animals successfully calls for a knowledge of habits and the employment of ingenious devices. This is particularly true of birds, which must be decoyed to within reach of the collector, who studies the circumstances, decides what he would do if he were the bird, and then stands by to see if the stratagem will work. Webb tells of numerous instances where former rarities in animals have become more common after he understood more of their peculiarities. The diversity of the regions visited—Africa, Asia, Australia, and South America—provides a variety of anecdotes, which are well told.

This is an entertaining and instructive book. The half tone illustrations are excellent, and there are a few line drawings, which are also good.

Harold E. Anthony

FIFTY YEARS IN ALASKA

- - - - - - - - - - - by Carl J. Lomen

David McKay, $4.00
302 pp.

SINCE the Klondike Gold Rush of the 1890's, the name Lomen has figured prominently in the development of Alaska. The brothers Alfred, Carl, and Harry have engaged in a number of successful business enterprises. One of their more imaginative ventures was the raising and marketing of reindeer on a large scale.

Wild reindeer existed in Alaska, but they were not suitable for domestication, so the Lomens imported a herd from Lapland, where reindeer had long been a source of food and transportation. The Lomen Reindeer Company was formed, ammonia freezing plants were built, and a natural cold-storage vault was placed in the ground-ice of a cliff. The company operated two large refrigerator ships to Seattle and made reindeer meat available all across the United States. Trained reindeer teams advertised the industry in Christmas parades.

For many years, attempts were made to interest the Eskimos of Alaska and Canada in the industry, but it did not work out as hoped. Eskimos are hunters, not herders, and the young men could not be induced to spend months away from their villages tending the herds. Many deer were lost to the wolves or strayed with the caribou (wild reindeer native to North America and Greenland).

The Eskimos did not own the deer individually but had "shares" in village herds, as is their custom with other property. So when the herds began to diminish, many of the "shareholders" began to "cash in" their stock, even shooting deer to serve as bait for fox traps.

I personally saw one result of Eskimo experiment with herding. In 1931, I was in Barrow, Alaska, and helped corral 20,000 reindeer in the Fall of that year. Today that village owns not a single deer.

James A. Ford

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OCCASIONALLY, the botanist, who is ordinarily wrapped up in investigations of uncertain import in the minds of laymen, gets an assignment that is obviously important to everyone.

It was almost by accident that I received such an assignment in the tropical jungles of South America. The objective was to insure a nearby source of a vitally important strategic material — rubber — and eventually to lay the foundations for large-scale rubber plantations in the Western Hemisphere.

It began in 1941. I had gone to Colombia to penetrate the headwaters of the Putumayo River, where I intended to spend a year studying useful plants—especially narcotics and stimulants—known to the Indians in those far-off forests.

While I was in the interior, the Japanese struck Pearl Harbor. The news filtered in to me about a month after December 7th, but as soon as word reached me I began the trek back to Bogotá. There I found the Rubber Development Corporation, an agency of the U. S. Government, industriously organizing groups of foresters, botanists, and engineers. Our country needed an emergency source of natural rubber (for it was by then certain that the Japanese would seize the plantations of the East Indies), and these specialists were being mobilized to find ways of extracting it from the millions of wild trees in the Amazon Valley.

I was asked to join; agreed to do so, and was promptly sent back into the jungle — this time with much more than an academic interest in useful plants. My assignment, which occupied me for a full year, was to seek out, map, and count stands of wild rubber trees along little-known rivers of eastern Colombia.

It was planned that, once a flow of rubber from wild trees was assured, attention would be turned to a long-range project. So, in due time, the U. S. Department of Agriculture, along with several Latin American countries, launched an even more ambitious program: establishment of large-scale rubber plantations for the first time in the New World.

A corps of specialists was brought together, each of whom had a special task. Mine, as botanist, was to scrutinize stands of wild rubber growing in the Colombian and Bra-

River
Putumayo

A botanist describes his . . .

Twelve Years in a "GREEN HEAVEN"

As told to ARTHUR F. JOY

By

RICHARD E. SCHULTES*

All photographs by Richard E. Schultes, USDA, unless otherwise indicated

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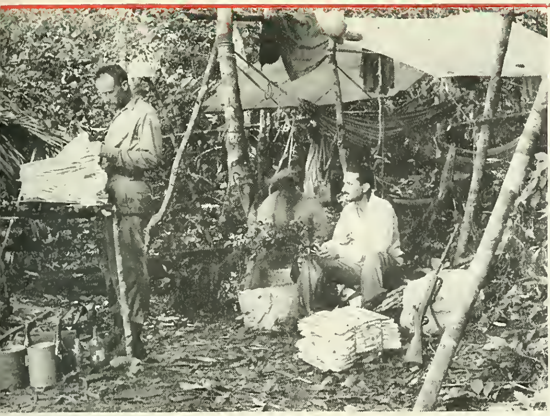
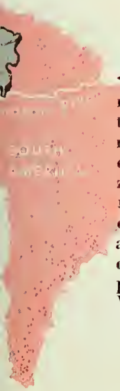
*Dr. Schultes, at present Curator of the Ames Herbarium at the Botanical Museum of Harvard University, was one of a number of scientists and technicians employed by the government and private companies to improve and expand rubber growing in the New World. Working as Botanist in the Rubber Plant Investigations Division of the Bureau of Plant Industry, U. S. Department of Agriculture, Schultes has recently returned from extended explorations in the Amazon Valley aimed towards a search for rubber trees of higher yield and disease resistance.



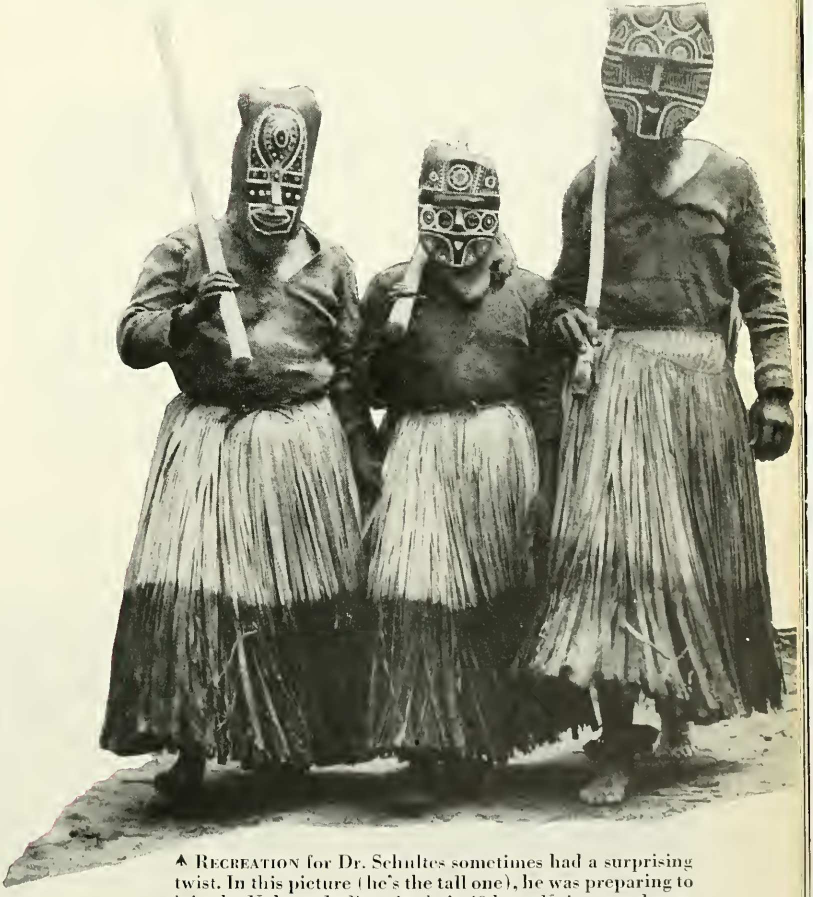
▲ **Living quarters** in the Colombian Amazon were necessarily primitive. Dr. Schultes (standing) examines a collection of plants made near the Falls of Jirijirimo on the Apáporis River.

▲ **Travel** was by waterway. Most of the expeditions were made in an 18-foot aluminum canoe equipped with an outboard motor.

Did you ever wonder what
it's like to be a plant explorer
in the tropics?
Here are the reminiscences
botanist who spent more than
a decade in the jungles of
Colombia and Brazil



◄ **The scope** and demands of his studies took the botanist up countless remote jungle waterways of the Colombian Amazon. Some of his more rewarding experiences occurred in the Leticia area, and along the banks of the Putumayo, Apáporis, Miriti Paraná, and Vaupés Rivers.



▲ **Recreation** for Dr. Schultes sometimes had a surprising twist. In this picture (he's the tall one), he was preparing to join the Yukuna Indians in their 48-hour Kai-ya-ree dance.

zilian jungles for the occasional tree of promise, and to get living samples of superior types into nurseries for testing. To me, this represented the opportunity of a lifetime. Besides the chance to explore the secrets of the rubber tree, it would permit the study of hundreds of rare, unusual plants, some of which had never been known to science.

My one-year stay in the jungle was destined to stretch to twelve. In the years that followed, my fellow scientists and I collected hundreds of elite individual rubber trees, or *clones,* and tons of rubber tree seeds —all of which were flown to various nurseries for study.

Capsule results of this concentrated group effort are difficult to present, but suffice to say that production of rubber from wild trees in the Amazon rose by thousands of tons during the war, and that the painstaking scientific studies provided vital background for present and future rubber plantations.

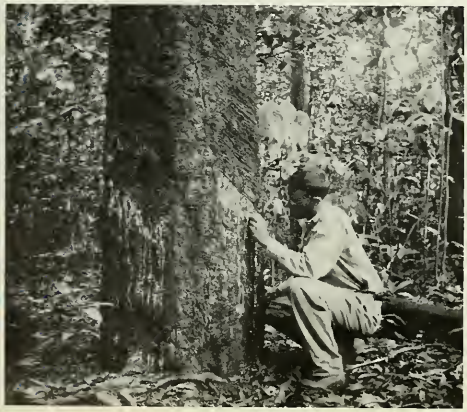
The area in which we worked, the Amazon jungle, is vast almost beyond comprehension—two million square miles, the largest forested region on earth — interrupted only by rivers feeding into the world's greatest waterway. Actually, there are many kinds of forests in the Amazon Valley, and the rubber trees we sought were found in several of them. To get what we wanted it was necessary to travel widely and to live in primitive regions for

▲ PEDRO, Dr. Schultes' Indian assistant, was the son of a witch doctor and well-versed in jungle narcotics. Here, he is preparing *paricá* snuff, a powerful drug used by primitive mystics.

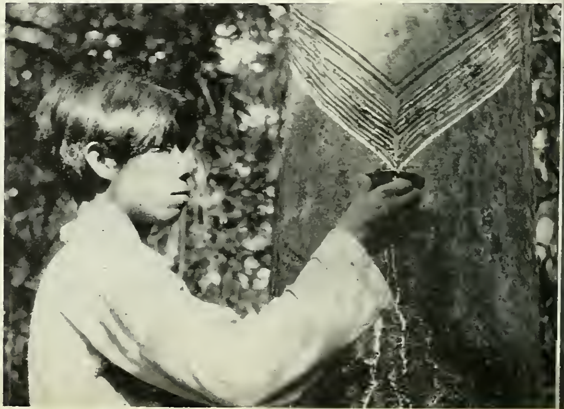
▲ ISIDORO CABRERA, a white-Indian *mestizo*, was another faithful assistant for the venturesome botanist. Though Isidoro grew up on a cattle farm in eastern Colombia, he took quickly to navigation on Amazonian waterways.

▼ A YUKUNA INDIAN offers snuff to Dr. Schultes through a composite bone and wood tube. The scientist's arms had been painted in preparation for a tribal dance in which he participated.

▼ DR. SCHULTES examines a tree of *Hevea brasiliensis,* some of which show promise of excellent rubber and possible resistance to leaf blight. Bud wood material of this tree was shipped back to plantations for testing.



▼ THE INDIAN of the northwest Amazon is an excellent rubber gatherer. Each day, he trots through the forest on almost invisible trails, cutting the bark of up to 150 trees, inserting a little cup under each cut, and returning before sunset to gather the "white blood" the trees have yielded.



months, since a botanist literally must live with plants to be successful in his efforts. He must study them throughout the year to obtain both flowers and fruit, watch changes in the leaves, and evaluate the effects of high and low water. Only through long and intimate association with a particular plant can he come really to understand it.

For example, I spent three years studying one species of rubber: *Hevea brasiliensis.* This, the most important species of commercial rubber tree, is common in Peru and Brazil south of the Amazon, but occurs north of it in Colombia only in one small patch—a small colony of about 150,000 trees in the Leticia area, along 80 miles or so of the Amazon River. I worked this small area over very carefully because these trees seemed to possess a natural resistance to the leaf blight, a characteristic we were seeking. We sent out several hundred selected clones and about 1,440,000 seeds—seven tons of them. These seeds, shown by experiment to be more resistant than usual, were used for root-stock in several of the budding nurseries in tropical South America.

▲ An Inga Indian of the Putumayo region sights his 8-foot blow gun at a monkey. A strong puff will direct a poison curare dart to a small target in the upper branches of a 100-foot tree.

Helping hands

Scientists at work in an area like the Amazon Valley cannot possibly succeed without help from all kinds of people. I received invaluable assistance from Colombian government and army officials, Colombian scientists, missionaries, businessmen, farmers, workers, and last, but certainly not least, the Indians. I might not have even survived, much less accomplished any botanical work, without help from loyal, hard-working Indians who knew every bend in the rivers and every hill in the forests.

One lesson I learned early is that much of the paraphernalia usually lugged along on jungle expeditions is quite unnecessary, especially much of that highly prized in military circles. High boots, jungle hammocks, complicated tents and the like never weighed down my canoe. The lighter an explorer travels in the Amazon the better. This applies to food, too. Contrary to current belief, the natives of the Colombian Amazon are well fed, and there is no reason to shun their diet. I have never seen an Indian with beri-beri, but I have seen many white men with it and have had it myself. At the start of each trip, I stepped into my canoe carrying only my medicine kits and a few tins of emergency rations. For the rest, I depended on the Indians.

Through the years, I had a number of outstanding natives with me. During the last three, for example, my crew consisted of Isidoro Cabrera, a 30-year-old white-Indian *mestizo*, and Pedro, an Indian of the Puinave tribe. From time to time, I would pick up an extra boy or two as interpreter, local guide or tree climber, or for help in getting around rapids. These lads were usually 12 to 15 years old—always exceedingly vigorous and alert.

Isidoro, though not an Amazonian by birth, had worked with other botanists before me. He had been thoroughly converted to working with plants and animals as a life's calling, and gladly came along with me into lands he had never seen. He soon learned to run the outboard motor on my 53-pound aluminum canoe and quickly took to the waters of the great rivers.

The other boy, Pedro, was unbelievably skilled in navigating through rough water. He would stand up in the prow of the canoe while Isidoro and I piloted it with paddles or used the motor at very slow speed to get through the strong rapids. A slight miscalculation on his part could easily have dashed us all to death against the rocks, but Pedro had the knack of telling instantly which way was best. Often it was the *only* way to go. Like all Indian boys, he was a great tree climber. While Isidoro or I would use climbing irons, he would put a loop of bark between his feet for good grip and, by a series of short jumps, go up much faster than we.

Pedro was contemplative to the point of impressing most whites as moody, probably due to the influence of his father, who had been a witch-doctor. He remembered much plant lore from his father's teachings, and it was he who helped clear up a mystery of long standing to me: the identity of the plant used by these natives to make their powerfully narcotic *paricá*-snuff. It is used by witch-doctors to throw themselves into a delirious stupor, during which they divine and prophesy. Pedro made some for me from the bark-resin of a tree belonging to the nutmeg family. It is such a strong narcotic that a small dose of it made me sick for two days.

"Lost Worlds"

One of the most fascinating areas I visited on my trips was the Apáporis River in Colombia, which requires a poet's pen to do justice to its vast solitudes. Botanically, I consider it one of the most absorbing regions on earth.

Practically no Indians inhabit the main river, which is hedged in by an immense forest still to be studied in all its phases. I first went there in 1943, because a few white people had brought back glowing tales of its wealth of wild rubber trees. It is much more accessible now, since a Colombian airline provides transportation to the area and a group of Colombians are pushing a colonization scheme based in part on production of wild rubber.

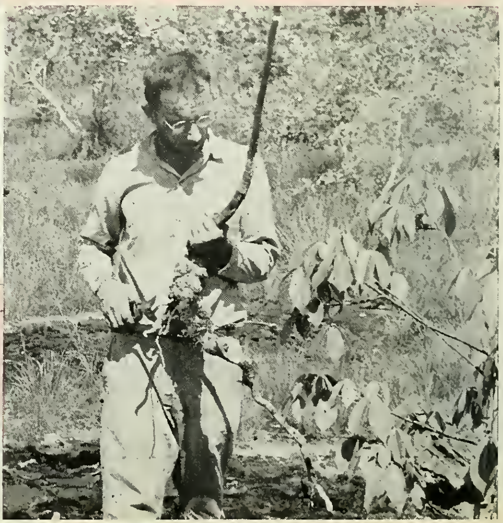
But then it was different. It was while exploring in the headwaters of the Apáporis in 1943 that we came upon some curious sandstone mountains—a discovery that was to mark the beginning of a ten-year exploration of many of these unknown land-masses. Most of the Amazon Valley is flat; but these mountains, grotesquely eroded, rear up like ancient castles and cathedrals. I know now that they are remnants of a once more or less continuous mountain-mass that extended in an arc from eastern Colombia across southern Venezuela to British and Dutch Guiana. The isolated mountains of today represent hard cores that have resisted erosion through the ages. The plants surviving on their tops are anachronisms and show many unusual adaptations. For this reason, the mountains are often called the "Lost Worlds." Many of the plants from their domes are not related in any way to plants in the surrounding Amazon forest. Among them, one finds many that are either new to science or have their closest relatives far away in the mountains of Venezuela and the Guianas.

If I had been adhering to a routine study of rubber alone, I would never have made a discovery there that has since proved to be significant in a broader understanding of the rubber plant. One day, tired of tedious portaging, my boys and I decided to scale one of those intriguing sandstone domes. We could hardly wait to see the dwarf vegetation on the top, a blurred preview of which my glasses had given us.

When we arrived at the crest of the sun-baked ridge, we discovered the summit was covered with dwarf rubber trees! Instead of towering 100 or 150 feet, they were only 6 to 8 feet tall! There were hundreds of them. Some were so small as to be lying almost flat. We chopped up one tree and started it on a long odyssey by Indian-back and canoe that took it eventually to Washington, D. C., for analysis by the Bureau of Standards. The dwarf tree was found to contain rubber of good quality; but the trunk, of course,

▲ Sandstone mountains, rearing up like ancient fortresses above the green plain, were treasure troves of rare and unusual plants.

▼ A dwarf rubber tree was Dr. Schultes' most exciting discovery on the sandstone mountains. He called it *toxicodendroides*, because the leaves reminded him of poison ivy.

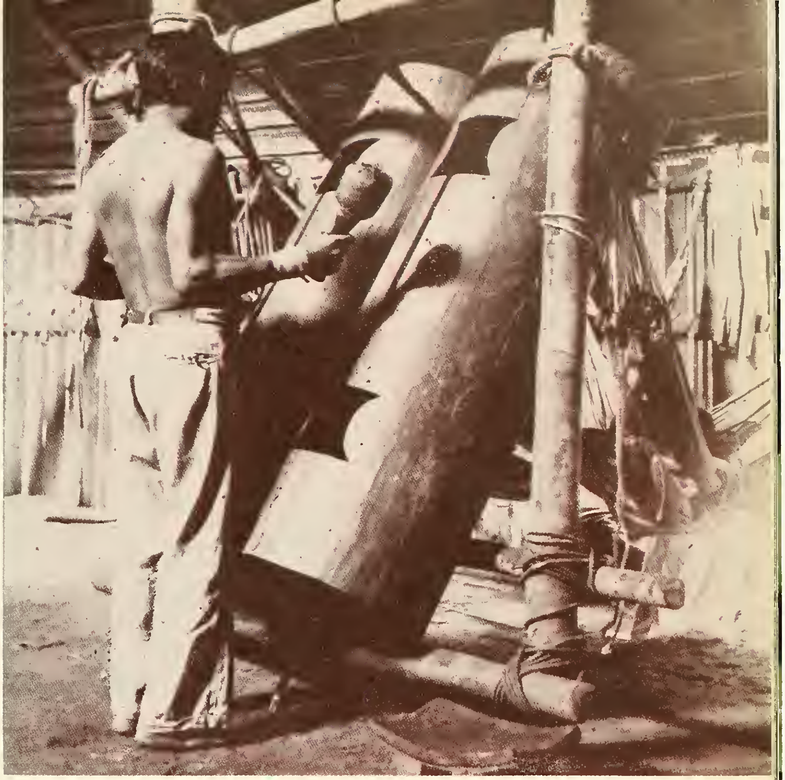


was too small for tapping. We called it *toxicodendroides,* a word meaning "resembling poison ivy," for, with its three, typical, glossy, dark green leaflets, the similarity is indeed striking.

Despite the economic limitations, I found the little tree intriguing academically. I wondered if I had stumbled onto a primitive kind of rubber tree. I could not be sure, however, because the extreme scarcity of soil on the mountaintop might have accounted for the stunted growth. Furthermore, the mountaintops were actually deserts; there was nothing on them to keep the heavy rains from running off quickly. So, on a second trip, I secured a living specimen and had it planted in the fertile soil of a rubber nursery where the yearly rainfall sometimes reaches six yards! Would the treelet grow larger under these conditions, proving it only an ecotype (a variant produced by environmental conditions)? Or was it a real, stable variety?

After many months of growth under the best of conditions, the little tree was somewhat more luxuriant, but still bushy and small. Thus we had something of considerable interest to geneticists working for a deeper understanding of the rubber tree.

There is more, much more, to be investigated in these forests. There is the curious liana *yoco,* which the Indians of the Putumayo area of Colombia use as we do coffee, and the bark of which actually contains caffeine. There is the violent narcotic tree with hanging, white flowers ten inches long—a genus and species totally unknown to botanical science and as yet not described—used by the witch-doctors of certain tribes to bring on a very dangerous intoxication. There is the discovery of a six-foot member of the pipewort family and several new species of trees related to *Hevea*-rubber, the re-discovery of scores of plants that have not been seen by botanical explorers since the first collection a hundred or more years ago, the encountering of beautiful new species of orchids, and the identification of some of the food-plants that the Indians have cultivated or used in the wild for years, but which had not been known to us with certainty.



▲ JUNGLE COMMUNICATION is facilitated by the *manguare,* with which Indians of the upper Amazon thump out messages to tribesmen up to a day's travel distant. The hollowed-out logs are of unequal size and give out slightly different tones when struck with rubber-tipped drumsticks.

Jungle friends

An absorbing corollary to my botanical work was an attempt to learn some of the ways and customs of the Indians. There are said to be some 60 different Indian languages in Amazonian Colombia. Most of these are dialects spoken by only a few people, but there are at least four spoken by a great many: Witoto, Tikuna, Cubeo, and Tukano. Each of these four represents a tribe of from 2,000 to 4,000 people.

All of these Indians are peace-loving. Most tribes are submissive, but a few, like the completely untouched tribes dwelling along the Piraparaná River have, in recent years, killed a number of unscrupulous rubber men who tried to force them to work in forests far from their homes.

We were constantly warned against going up certain rivers, but I found the natives to be good and helpful. I think that perhaps a botanist can get along especially well with them because he shares a common interest. They, too, live with plants, and are naturally curious about anyone whose entire effort is directed toward their collection and study.

"What is this plant used for in your country?" they would ask repeatedly. "Why do you want it?"

It is often hard to explain, especially with language deficiencies, but usually it is easiest to say that it is a good remedy for some disease. Often, a lively discussion would fol-

▲ TINY INDIAN BABIES are bathed regularly in rivers that flow by their homes. The waters apparently are so pure that there is no danger of infection.

LITTLE KAPI was the son of a Taiwano chieftain, and worked for Dr. Schultes as a guide and tree-climber. When he accompanied the botanist to the tiny Colombian town of Mitú, he requested payment in clothing. The transformation is seen at right.

low, leading to interesting information.

Practically all of the inhabitants of this huge region in Colombia live on fish, game, and farina. The last-named is a dry, pulverized product of the poison yuca or tapioca plant (*Manihot esculenta*) and is their main source of carbohydrate. The dry meal is unpalatable to civilized whites, but the natives always carry a basketful of it when traveling. The poison is leached out by two or three washings. Even the violently poisonous water is put to use; the natives boil it down, until it becomes as thick and brown as molasses and until all of the poisons are broken down by heat. The result is a thick syrup called *tucupí*, a delicious condiment when spread on meats. Tucupí has a taste difficult to describe; the natives add chili peppers to it for extra flavor. It may be a good source of vitamins.

Just as essential as food to these Indians is their coca. The coca plant (*Erythroxylon coca*), from which cocaine can be extracted, is cultivated on a vast scale all over Colombia's Amazon. The Indians prepare it differently from the people in the Andean highlands. The Amazon natives toast and pulverize the coca leaves. The resulting powder is mixed with ashes of the leaves of the *yarumo* tree (*Cecropia*) to produce a gray-green mixture. In some tribes, coca is chewed almost continuously throughout the day.

Campaigns against coca are being waged by some local governments and by certain international groups. Colombian missionaries and government officers sometimes attempt, in the fastnesses of the Amazon jungles, to deprive the Indian of his coca. But their efforts are futile. As used in the Amazon, it does not seem to be a physiologically habit-forming drug or appreciably harmful. The Indian will never go on long canoe trips or hunting expeditions without his chew of coca, and one of the great preparations for dances, in which the whole tribe takes part, is the making of huge quantities of coca for the guests. Coca, incidentally, can be of incalculable help to the plant-explorer who wants to go through the day without eating at noon, for one of its useful properties is a deadening of hunger pangs.

A great tribute

One of the friendliest gestures an Indian can show a white man is the preparation of a tribal dance in his honor. All the native dances are fascinating, of course, but there was one that held my interest especially and in which I took part.

It was among the Taiwano Indians on the Kananari River. Refreshments for the dance were *chicha* and *yajé* (also known as *caapi*). *Chicha* is a slightly fermented drink which may be made from whatever fruit happens to be in season—pineapples, peach-palm, or other—and is prepared in a dugout canoe. At this dance, the Taiwanos were drinking pineapple chicha, and we danced and drank until the canoe was empty. Intermittently, some of the participants were also drinking *yajé*, a narcotic derived from a jungle vine (*Banisteriopsis Caapi*). Yajé induces colorful visual hallucinations. When under its influence, the Indians often stop dancing, sit back, and lapse into a pleasant laziness.

I drank some of this drug. The experience could be described by no other word than "pleasant." First there came a sensation of ease and well being, after the heat of the dance. Then the visual effects began. I found myself gradually becoming aware of the largeness of the round Indian house in which we were sitting and of the extreme brightness of the fires. The flames, to my astonishment, gradually turned a hazy blue! I did not experience the extreme visual hallucinations that the natives assert yajé induces. There can be no question that they see jaguars and other animals, but the hallucinations come in a semi-dream state and usually are not frightening to them.

Some tribes use an overdose of this drug to bring on an artificial bravery. It is used, for example, in the fast-disappearing Yuruparí dance, in which boys to be initiated into manhood must stand up under unmerciful lashings. Older men do the lashing, and it is severe enough to raise welts! Sometimes the beatings result in death. Should a boy flinch during the ceremony, his coming-into-manhood is put off another year, and with that goes his right to take a bride. Many are those who pass this crucial test thanks to the narcotic yajé.

Some of the happiest moments of my rubber-hunting days were spent with Indian tribes in their spacious, rain-proof, palm-thatched houses, observing their ceremonies and gathering information. Mingling with the natives helped break down their suspiciousness and made it easier to delve into their botanical lore.

The tribes that impressed me as having the most beautiful and weirdest of all Indian dances in Colombia, perhaps in all of South America, are the Yukunas and the Tanimukas. They inhabit the headwaters of the Miriti Paraná River and, while important tribes, are not even mentioned in our anthropological handbooks. They celebrate the

continued on page 165

▼ A FORM OF WRESTLING is a favorite sport of the Yukuna Indians. Each contestant pushes at his rival with a stout, gnarled stick, seeking an opportunity to land a punishing blow with it on a leg or arm muscle. Great strength and agility are required, and winners are fêted royally.

▲ THE CUBEO INDIANS of the Vaupés River are a happy people who love rhythmic dancing. The thumping stick (trunk of a young balsa tree hollowed out by fire) is used for marking time.

New York Zoological Society

Is THE GIRAFFE *Mute?*

The author answers "No," and describes the extraordinary circumstances under which she heard a giraffe "speak"

By Jane Stanton

ONE of the earliest writers on giraffes in Africa gave a description which, odd though it sounds, cannot be contradicted. Dr. Johnson's definition of a giraffe was "an animal which is taller than an elephant but not so thick."

There have been several controversies about them, though, such as whether giraffes drink, and whether they lie down. I can imagine that when the early explorers, having only just discovered giraffes, saw the creature lie down for the first time, they may well have thought that it was an action performed once in a lifetime. Indeed, it was only after considerable controversy in the press some years ago that it was decided that it is normal for giraffes to lie down. It was established fairly early that they drink. But the question of whether or not a giraffe is silent is another matter.

Keepers of a number of zoos throughout the world will tell you that a giraffe can make no sound whatever. The more cautious caretakers may add that at least they have never heard one. And every so often one reads that the giraffe has no vocal cords. Almost the only opposing suggestion I have ever heard is that the giraffe may discover its lost voice in moments of great distress or terror, and only when very young.

The latter part of this statement I am not in a position to deny from personal experience. But Mr. Blayney Percival, at one time a Kenya Game Ranger, in his book *A Game Ranger on Safari*, gives a description of an adult female that "spoke." This giraffe came regularly to a water hole over which the ranger watched, and he heard her utter from time to time a low, plaintive cry, which he describes as sounding like *Wa-ray*.

The first time I ever heard a giraffe make a definite sound was when my husband lassoed a young female about six months old. This young captive opened her mouth wide and bellowed as loudly as any healthy domestic calf. But once the catching was over, Sally became perfectly silent, and we never heard her voice again, though she stayed with us for months and became perfectly tame before finding a home in a Far Eastern zoo. On the other hand, a young male that was probably three or four months older than Sally, and was captured by the same method, made no sound on being caught. A few days later, however, he started mooing in the paddock. It was a sad, soft, infinitely remote sound, and he made it without apparently moving a muscle and certainly without opening his mouth. This must have been much the same sound as that made by Mr. Percival's cow, though he reports that he saw through binoculars that she opened her mouth to cry.

My husband once caught 25 giraffes in one lot by driving them into a large paddock, with natives on foot and on horseback as the drivers. Naturally, only a comparatively small percentage of them were small enough to be exportable, the limit for shipping being 10 feet, whereas an adult cow may top 15 feet and a bull around eighteen. It was necessary, therefore, to separate the export specimens, but before that could be done, they all had to be slightly tamed. The giraffe is a foolish animal and can never be trusted not to kick out at its best friend, no matter how tame it may appear to be. But it is also extremely inquisitive, which makes it easy to tame up to a point. A giraffe has to look at everything closely, as though terrified of missing something. Within a few days after their capture, all 25 of them would follow the boys who brought their food. As soon as the latter entered the paddock, they would sway their long necks up and down in an effort to see, smell, and taste.

After a few days of this, it was possible to lead the giraffes through a passageway with a forked ending, one fork leading into the paddock and the other out into the bush and freedom. Unfortunately, freedom was now unwelcome. It was something like releasing an ardent lover from the place in which his loved one was still incarcerated, except that in this case it was stomachs and not hearts that were troubled. So the freed giraffes waited around outside. It was sad to see them standing there, silently watching their smaller brethren eating the good grain, while all they could do was drool. A veritable Niagara of saliva dripped from their mouths over the paddock rails as they stood day after day in a silent, hopeless line.

When the giraffe is ready for mating, the bull makes a noise that is hardly more than a raucous cough. It is made as a war cry to other bulls. Beyond this presumably threatening challenge, the bull giraffe shows very little fight. Swinging his head, with its small, hide-covered horns, at his adversary is about the limit of what he feels it necessary to do.

Those three sounds, the bellow of the frightened calf, the *moo* or *wa-ray*, and the mating call, are certainly the limit that any self-respecting naturalist can allow. But actually, my husband and I once heard a giraffe make yet another sound.

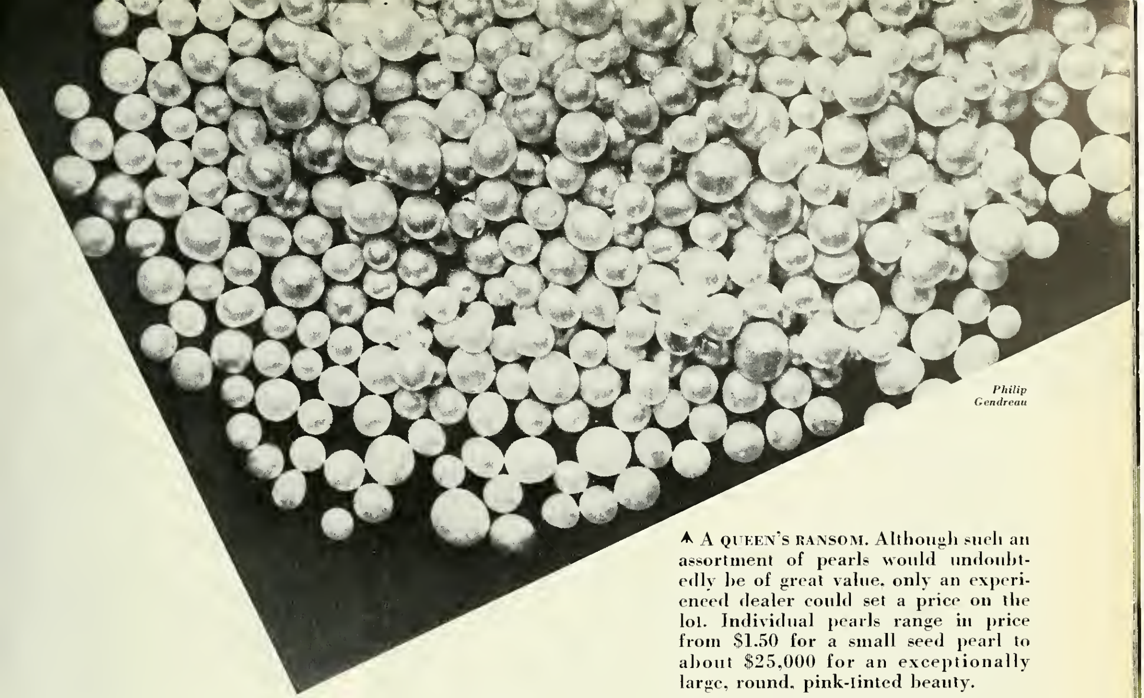
It was when we had a small herd in the paddock. Originally there had been 37, but most of the adults had already been released (and were doing their drooling act over the rails). But one cow, which had been due for release, had avoided foraging problems by producing a calf, which caused us to keep her in. She was quite tame by this time and must have been feeling very secure, if sound sleep is any indication. It was after dark, as usual, when we went to inspect the paddock to see that all was well, and we saw her sleeping. At the same time, we heard a sound — a soft, gentle, insistent, purring sound.

Believe it or not, but this giraffe was snoring!

This article is from a chapter in Dr. Abbott's new book, *Introducing Seashells,* published this month by D. Van Nostrand Company, Inc.

AMNH

↑ A POLYNESIAN DIVER explores a coral lagoon in search of pearl oysters. Scene is from an exhibit in the American Museum of Natural History.



Philip Gendreau

▲ A QUEEN'S RANSOM. Although such an assortment of pearls would undoubtedly be of great value, only an experienced dealer could set a price on the lot. Individual pearls range in price from $1.50 for a small seed pearl to about $25,000 for an exceptionally large, round, pink-tinted beauty.

Secrets of the Pearl

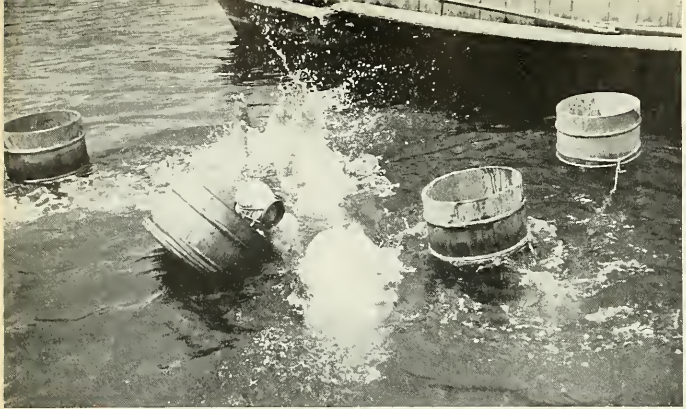
Beautiful women of all nations and all eras have regarded pearls as a symbol of elegance, but few people fully understand the fascinating details of their growth and variety

By R. TUCKER ABBOTT

WHEN you sit down to a plate of oysters on the half-shell or a bowl of oyster stew, your chances of discovering a pearl are about one in five thousand, and when we consider how many thousands of bushels of these bivalves are eaten each day, it is not surprising to learn that Americans annually find several hundred good-sized pearls at seafood restaurants. Unfortunately these pearls are of no commercial value, except perhaps to a few people who especially collect odd-type pearls.

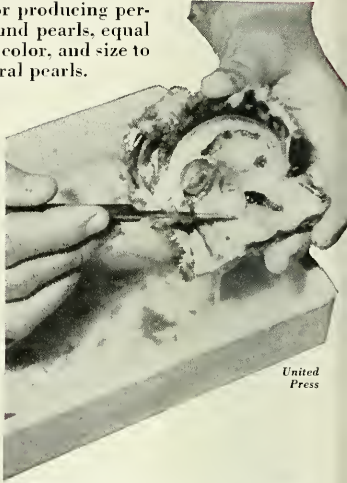
Almost every kind of clam, oyster, and mussel and many species of snails, whelks, and conch shells are capable of producing pearls, but only the true pearl oyster of the tropical seas can make the familiar gem pearls of jeweler's quality. Pearls, usually of lesser value, are found in certain species of river mussels or unios, the most notable example being the Queen Pearl from New Jersey, which was sold a hundred years ago to Queen Eugenie of France for $25,000. The common Blue Mussel of our northern coasts produces a small, highly iridescent pearl, while the Giant Tridacna Clam of the Indo-Pacific reefs has been known to make whitish, porcelaneous pearls larger than golf balls. Among the marine snails, the Queen Conch of the West Indies occasionally makes large, pink or coral-red pearls which have a silky gloss. The pearls of the Californian abalones are highly iridescent and many of them are quite large, although usually misshapen. Sizable pearls of unusual beauty, but limited commercial value, have been found in the West Indian Chank, the Marmorate Turban of the East Indies, the Nilotic Turban of the Indo-Pacific, and the Cameo Helmet shells.

Pearls are formed inside the soft parts of the clam or snail in the same manner as the shell itself is built. It is the fleshy mantle, richly endowed with shell-producing glands, which deposits the pigments and layers of shell. The color and luster of the pearl, therefore, are always the same as that found in the shell of the pearl-producing



◄ JAPANESE GIRLS retrieve "captive" oysters from a bed where they were placed five or more years before, after being impregnated with mother-of-pearl beads.

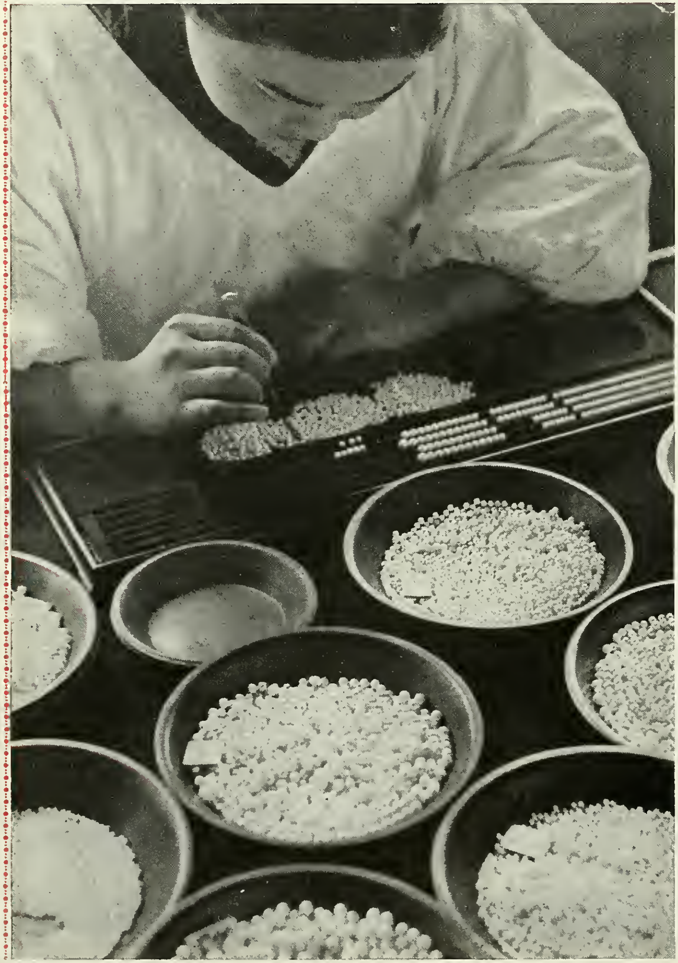
▼ A CULTURED PEARL is removed from its hiding place. Beginning in 1894, the Japanese spent 20 years developing techniques for producing perfectly round pearls, equal in luster, color, and size to fine natural pearls.



United Press

▼ A TRAINED EYE sorts cultured pearls which, someday, will be linked together in expensive bracelets, necklaces, and other jewelry. Cultured pearls have come to dominate the industry now that techniques for creating them have been refined.

Black Star



mollusk. Hence, our local edible oysters produce a dull whitish or purplish pearl, while the highly nacreous shells of the oriental pearl oyster is accompanied by a pearl of like sheen and color.

The shell of the pearl oyster is made up of several types of layers, the mother-of-pearl, or nacreous, layer being the most important. The pearls themselves are made up of many thin, concentric layers. Pearls are divided into four main types, depending upon how and where they are formed in the oyster—blister pearls, free pearls, muscle pearls, and hem pearls. Misshapen blister pearls are formed when some extraneous matter becomes lodged between the fleshy mantle and the shell. These foreign objects may be sand, worms, crabs, fish, or bits of broken shell, and their constant irritation causes the mantle to exude mother-of-pearl layers over them. Free pearls are most likely to be perfectly spherical, for they are formed inside the flesh of the man-

World's largest pearl. This huge (14-pound) misshapen mass, known as the Pearl of Allah, is the largest on record, and was found in a giant Tridacna clam of the Philippine Islands. The first native diver who attempted to retrieve it was drowned when the clam snapped shut on his probing hand.

AMNH

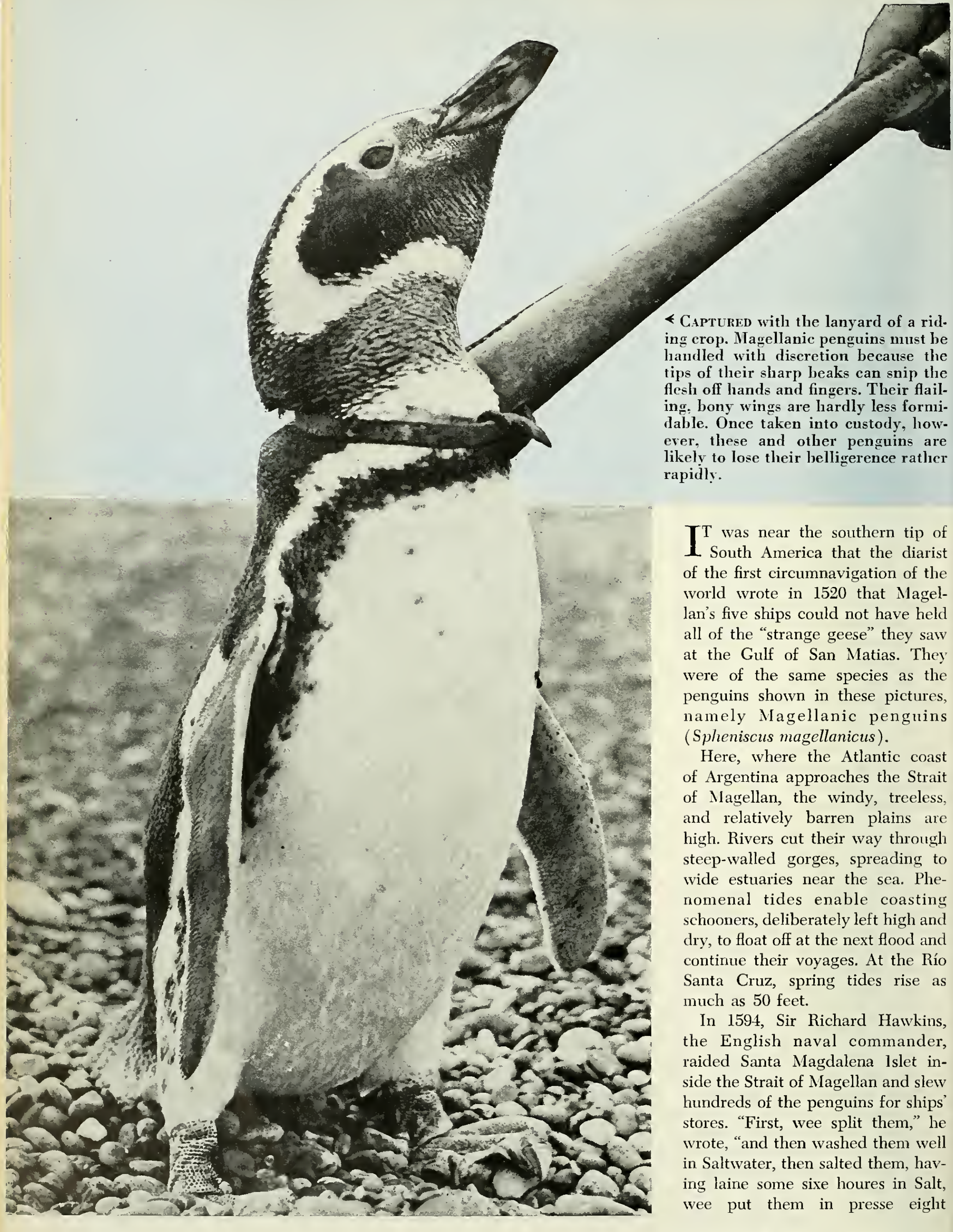
tle where succeeding layers of nacre may be added on all sides. The most perfectly colored pearls are formed near the center of the mantle where white, yellow, or pinkish tints are found. Hem pearls are formed near the margin of the mantle where the dark pigments usually produce brown, tan, or blackish pearls.

A pearl will start growing only when some foreign object becomes lodged in the shell-producing tissues or "pearl sac" of the mantle. This initiating nucleus may be of several origins. Among the nuclei which come from some outside source are parasites, the eggs of marine creatures, including the oyster itself, decaying parts of plants, sand grains, or particles of mud. Some pearls are believed to start when a few dead blood cells of the oyster itself become entangled in the tissues.

Pearls of gem quality are judged by their shape, weight, size, color, and orient. The latter term, *orient*, refers to two separate sensations of light—the luster (absorption and reflection of light) and the iridescence (interference of the light waves from the various transparent layers of nacre). A typical gem pearl is made up of about 4% water, 4 to 5% organic matter, and about 92% lime or calcium carbonate. If, through the years, a pearl loses its water, its surface becomes cracked. Pearls are easily dissolved in acids, as the high lime content would indicate, but the alternating layers of organic matter or horn-like conchiolin will normally prevent rapid melting. If Cleopatra tested pearls in wine, she probably had a number of days to wait for results.

Unlike diamonds, pearls deteriorate within a relatively short time, although the average life of a pearl is about fifty years and many still beautiful specimens are known to be several hundred years old. Pearls suffer from the drying effects of direct sunlight and the acid condition of the human skin, so that valuable strings which are worn frequently should be sent to the jeweler every year for cleaning. That ancient pearls will burst into a cloud of dust when blown upon is probably a figment of the imagination.

The cultured pearl of Japan deserves more respect than it normally receives, for it is not only a natural product of the pearl oyster, but it also requires much time and skill to produce. The idea of culturing pearls is a very ancient one, but it did not become successfully established as an industry until recent times when two Japanese, Mitsuku and Mikimoto, began investigating the death of pearl oysters sixty years ago. At that time, a "red tide" caused by the blooming of myriads of micro-organisms in the sea began to kill off Japanese oysters. The culturing of pearls was actually an outcome of their attempt to rear pearl oysters in the Bay of Ago in Japan. The usual method of producing cultured pearls is to insert a bead made from the shell of the pearl oyster into a small pouch or wrapping of pearl-producing mantle of a three-year-old oyster. The laying down of pearly material on this bead is a very slow process and one which may take five to seven years and the use of more than one "parent" oyster. From the outside, it is impossible to tell a cultured pearl from a natural one. If a hole has been drilled through the pearl, it is easy to detect the difference, but virgin pearls which have not been pierced must be put to a strong, transmitted light to demonstrate the parallel shell layers of the internal bead.



◂ CAPTURED with the lanyard of a riding crop. Magellanic penguins must be handled with discretion because the tips of their sharp beaks can snip the flesh off hands and fingers. Their flailing, bony wings are hardly less formidable. Once taken into custody, however, these and other penguins are likely to lose their belligerence rather rapidly.

IT was near the southern tip of South America that the diarist of the first circumnavigation of the world wrote in 1520 that Magellan's five ships could not have held all of the "strange geese" they saw at the Gulf of San Matias. They were of the same species as the penguins shown in these pictures, namely Magellanic penguins (*Spheniscus magellanicus*).

Here, where the Atlantic coast of Argentina approaches the Strait of Magellan, the windy, treeless, and relatively barren plains are high. Rivers cut their way through steep-walled gorges, spreading to wide estuaries near the sea. Phenomenal tides enable coasting schooners, deliberately left high and dry, to float off at the next flood and continue their voyages. At the Río Santa Cruz, spring tides rise as much as 50 feet.

In 1594, Sir Richard Hawkins, the English naval commander, raided Santa Magdalena Islet inside the Strait of Magellan and slew hundreds of the penguins for ships' stores. "First, wee split them," he wrote, "and then washed them well in Saltwater, then salted them, having laine some sixe houres in Salt, wee put them in presse eight

Patagonian *Penguins*

Strait of Magellan

The "strange geese" we now call penguins were first seen by Europeans in this region

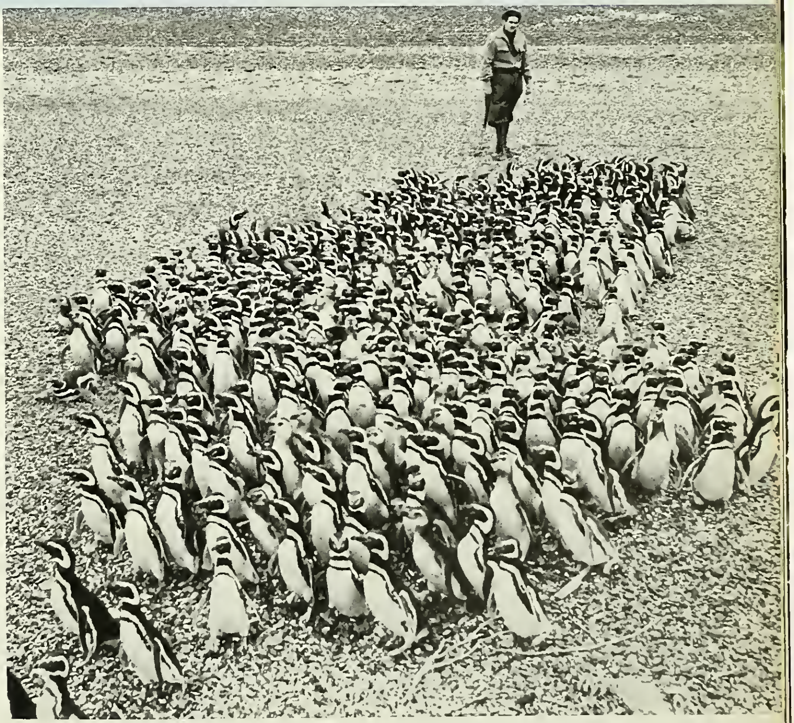
By Robert Cushman Murphy

Photographs by Richard Harrington, from Three Lions

houres, and the bloud being soaked out, wee salted them againe in our other caske, as is the custom to salt Beefe, after this manner they continued good some two moneths, and served vs in steed of Beefe."

Because people have taken such a toll from time to time ever since the days of the first discoverers, Magellanic penguins no longer exist in such hordes as they once did. But, fortunately, there is still a fairly large population at favorable breeding stations on both sides of southern South America, at the Falkland Islands, the islets off Cape Horn, and in the Fuegian channels. A few also persist at the Juan Fernández Islands. In the southern winter season, some of the penguins migrate as far north as Rio de Janeiro, where the tropical Brazilian fishermen scarcely know whether to call them birds or turtles.

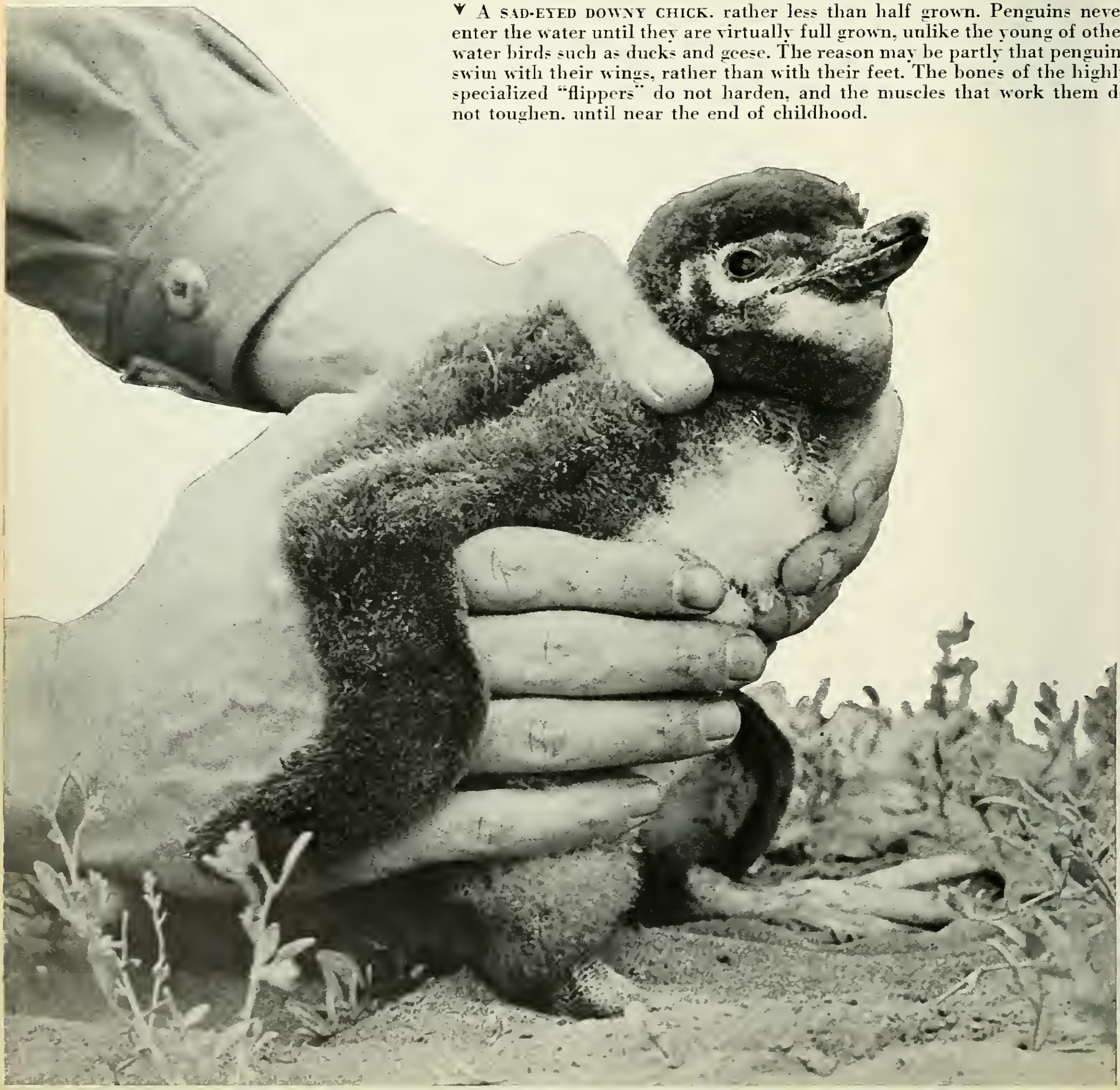
This penguin is a close relative of three other species, one inhabiting southernmost Africa, another the Peruvian coast, and a third the Galápagos Islands. All of them are cave-dwellers or burrowers. The Magellanic penguins, for the most part, burrow into peaty soil and lay two eggs in their dark, well sheltered nest.

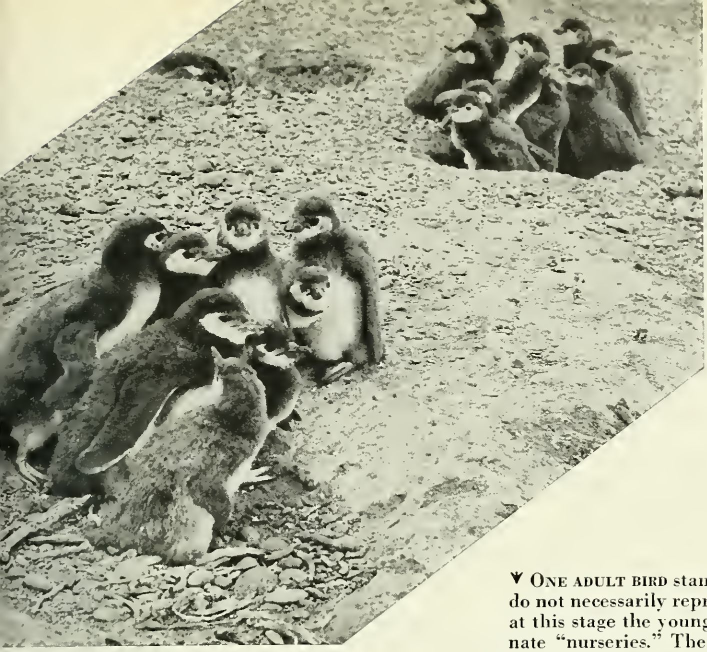


▲ A DROVE OF MAGELLANIC PENGUINS such as astonished Magellan, Sir Francis Drake, and other voyagers of the Golden Age of Exploration. Fledglings can readily be distinguished among the adults. They lack the double black bands across the neck and upper breast, and the "bandit's mask" over the eyes and cheeks. About a year later they acquire their first grown-up clothes.

< In the estuary of the Rio Gallegos, just north of the eastern entrance to the Strait of Magellan, lies one of the historic penguin islands. It is possible to go by horseback to the island when the tide has left the river flats bare. The birds in the air are kelp gulls (*Larus dominicanus*), which abound near penguin colonies and occasionally seize unprotected chicks.

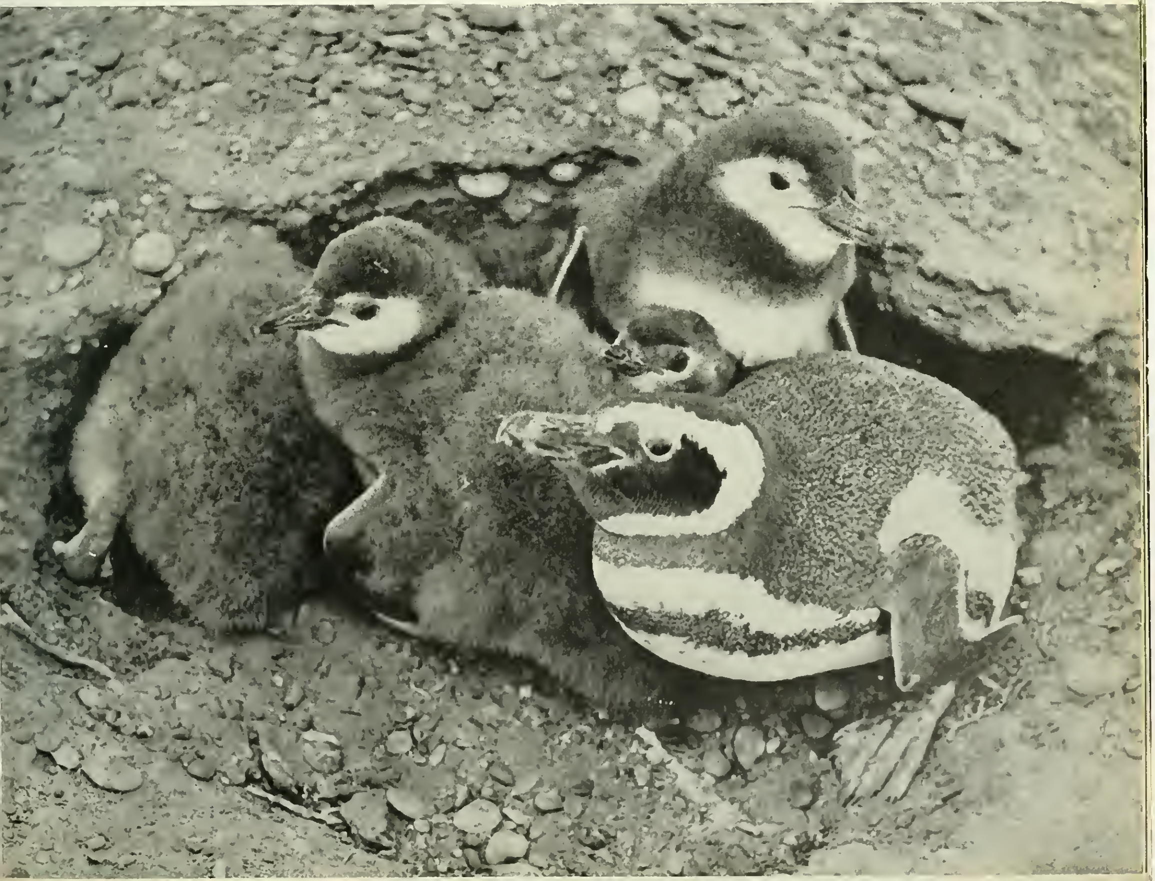
∨ A sad-eyed downy chick, rather less than half grown. Penguins never enter the water until they are virtually full grown, unlike the young of other water birds such as ducks and geese. The reason may be partly that penguins swim with their wings, rather than with their feet. The bones of the highly specialized "flippers" do not harden, and the muscles that work them do not toughen, until near the end of childhood.

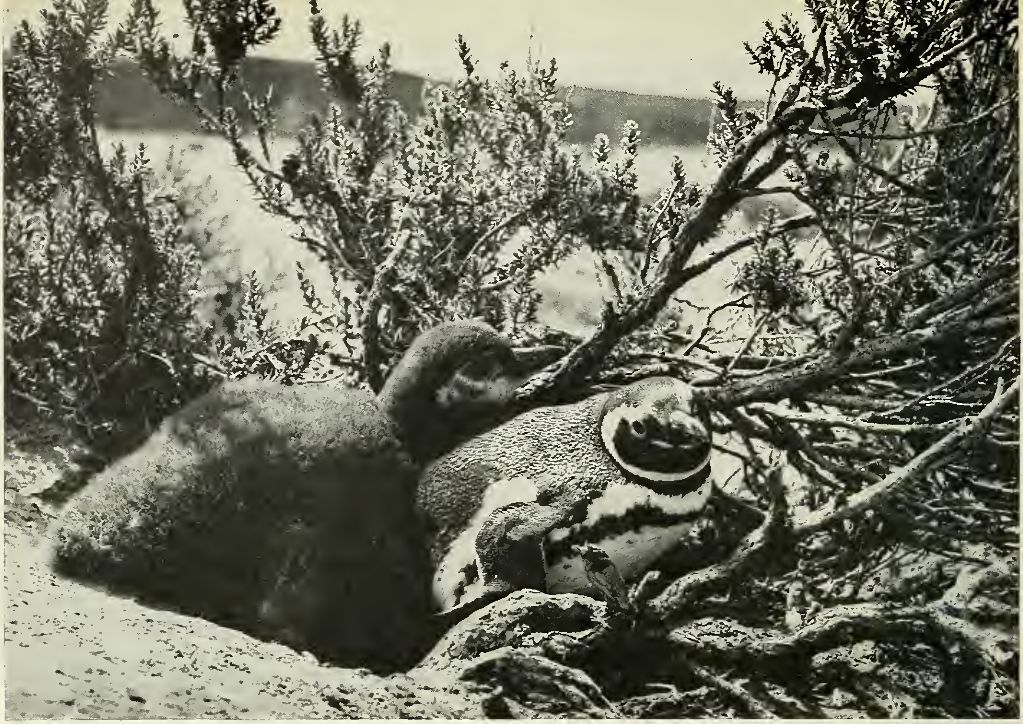




◂ Scared and hissing, these baby Magellanic penguins huddle together for comfort or courage. The slight excavations look like old and collapsed nest burrows. This ground, made up mostly of river shingle, seems hopeless for digging, but the adult penguins are mighty moles, scratching with their powerfully clawed feet and sending a spray of soil and pebbles out behind them.

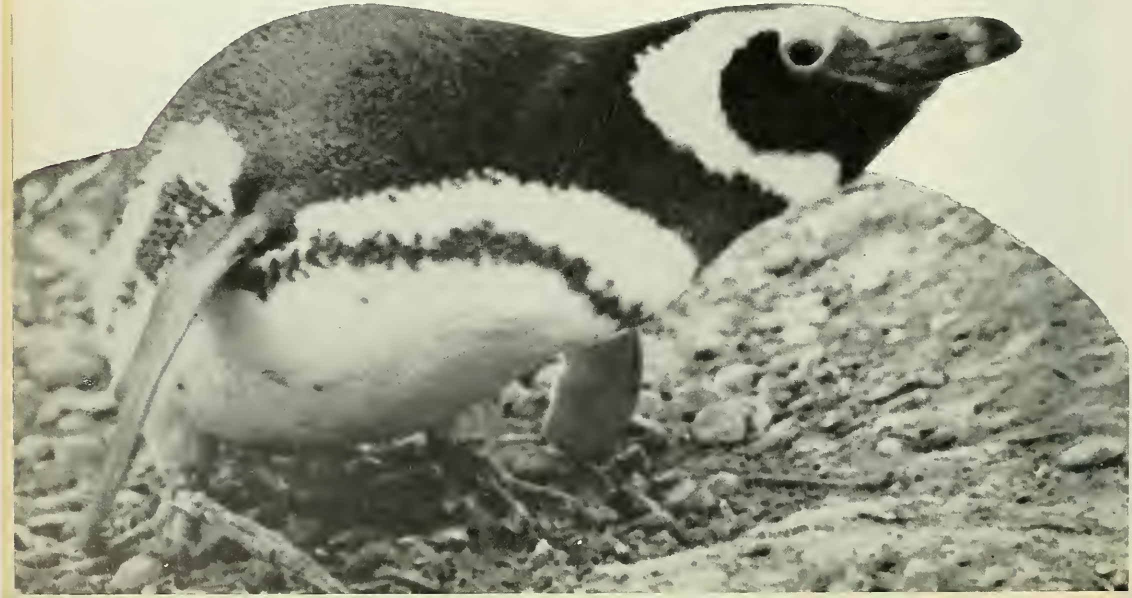
▾ One adult bird stands guard over four chicks. The chicks do not necessarily represent two pairs of nest-mates, because at this stage the young assemble in more or less indiscriminate "nurseries." The down on the center chick has been partly shed, as can be seen at the bend of its wing, where the smooth scale-like feathers of adult plumage show clearly.

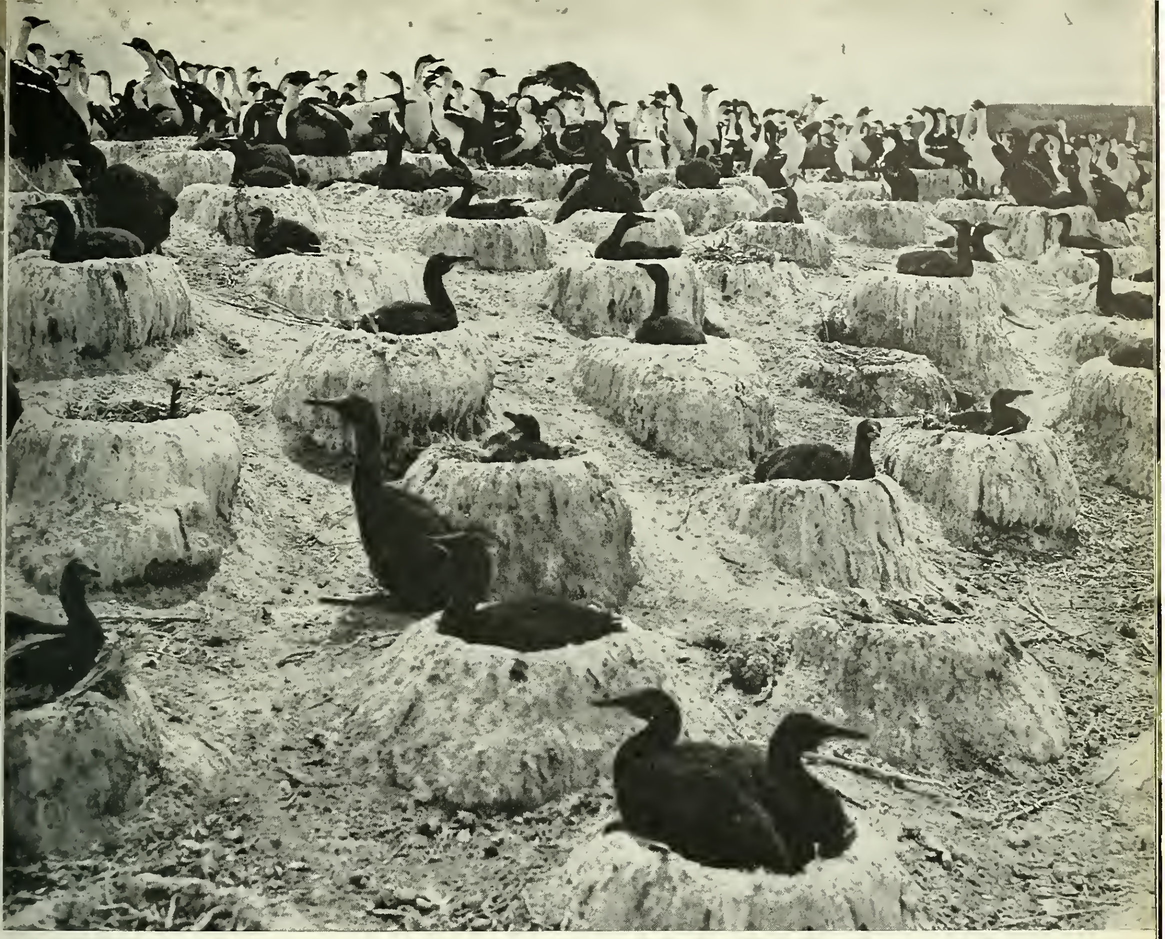




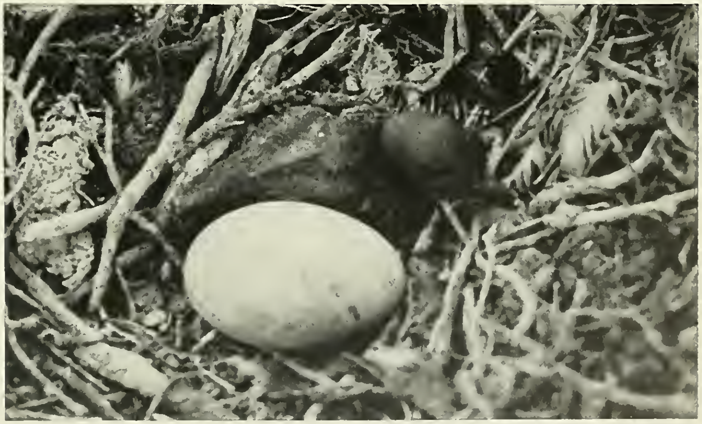
▲ Magellanic penguins, unlike other species, are rather indifferent as to the kind of terrain in which they make their homes. At the Falkland Islands, it is usually grassland; but along the Patagonian shores, shrubby country is equally welcome. In the extremely wet zone of southern Chile, the birds beat pathways from the beach into heavy rain forest and burrow into the soggy floor.

▼ A Magellanic penguin at bay. Bill and flippers are both ready for action. The birds are somewhat "wall-eyed," adults perhaps more so than chicks. Bifocal vision is difficult, if not impossible, for them. Therefore, when cornered, they weave the head very rapidly so as to see a possible enemy first with one eye and then with the other. Their loud protests sound like the braying of a donkey.

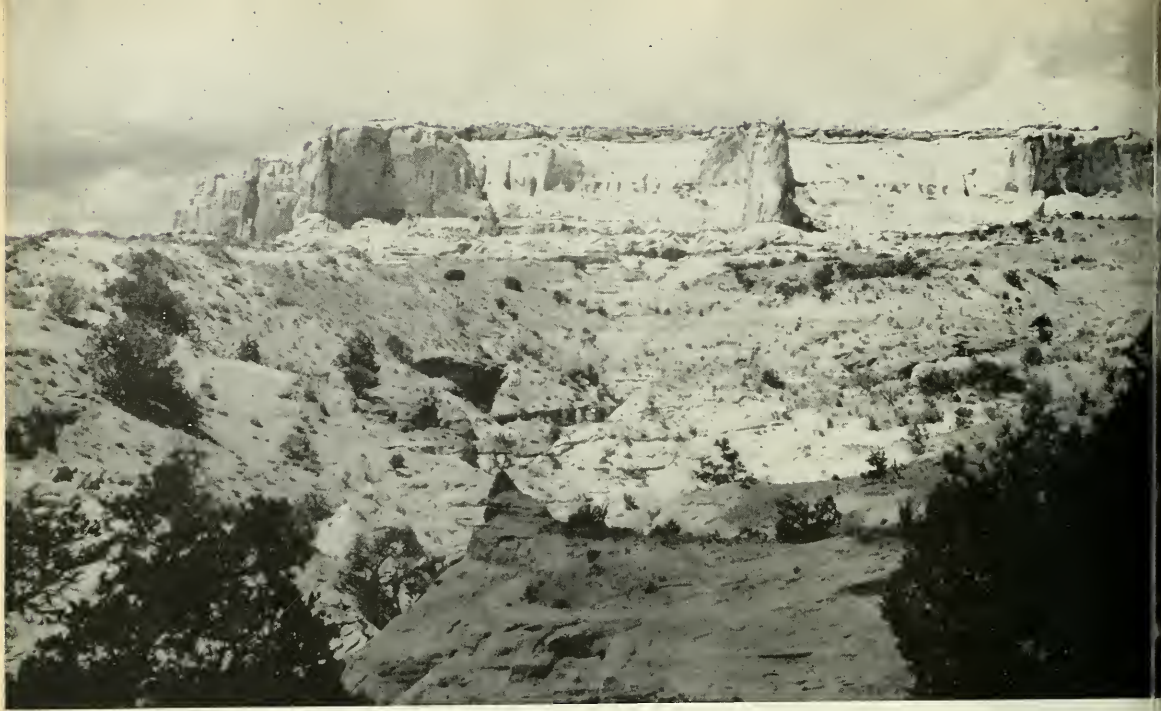




▲ **Throughout the Magellanic area**, cormorants, or shags, are apt to be close neighbors of the penguins. This colony, with mud nests occupied by well-grown young, is at one end of Penguin Island, Rio Gallegos. Several species of handsome, white-breasted, blue-backed cormorants are found in southern South America. This one is the king shag. The down of the young birds is almost uniformly clove brown. Nests are lined with seaweed and other beach debris.



➤ **Cormorants** and all their near relatives are hatched naked. Since the young are highly susceptible to heat or cold, they must be closely brooded by the parents until the down sprouts. Two eggs are the normal number. They are laid a day or more apart, and one little king shaglet usually has a correspondingly earlier start in life.



▲ SIXTEEN MILES LONG and 8½ miles wide, White Mesa rises deep within the Navaho Reservation in northern Arizona.

In centuries past, the elements have cut a series of narr gorges into the tableland, all draining toward the w

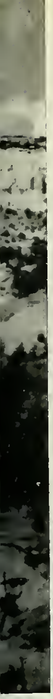
We Explored
WHITE MESA

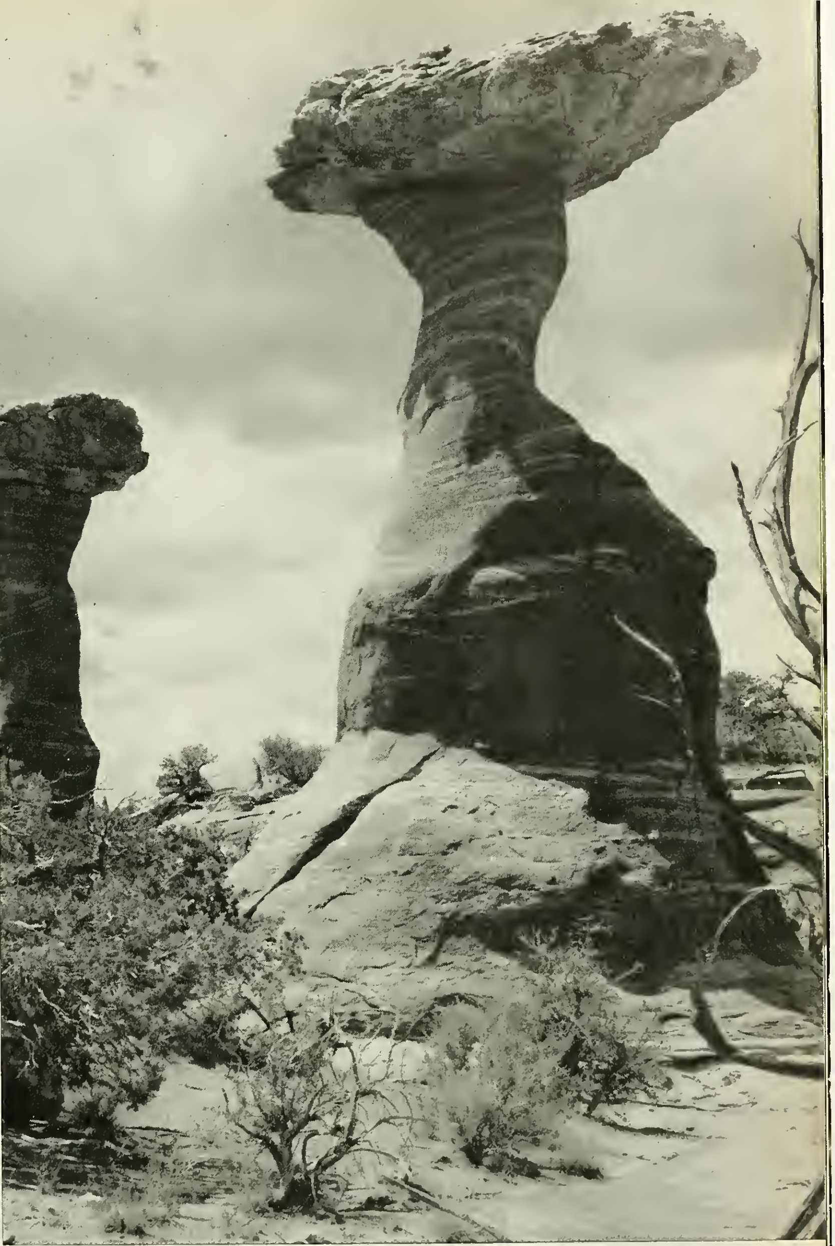
In a day when unexplored territory is thought to lie only at the uttermost ends of the earth, it is exciting to find an untouched gem so close to home

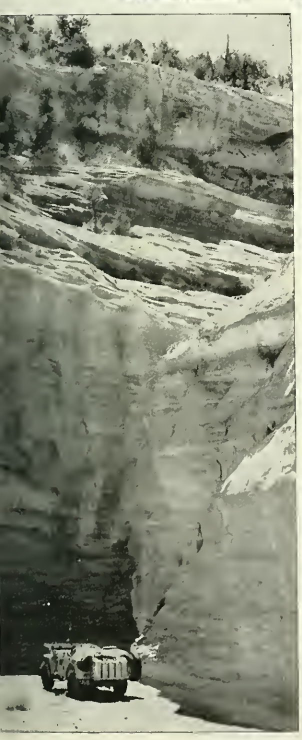
By WILLIAM C. MILLER
Photographs by Helmut Abt and the author

DEEP in the Navaho country of northern Arizona is a tableland of such spectacular grandeur that its scanty mention in geological and archaeological literature is nothing less than astonishing. It has been known for years simply as White Mesa. From a distance its intricately eroded battlements gleam in the sunlight like the Chalk Cliffs of Dover. Somehow, desert travelers seem to have passed it by through the years, and very little has been written about it.

My companions and I, during frequent excursions into the Navaho country, gradually developed a mounting curiosity about what lay beyond those albino battlements. Several years ago, when we first attempted access to them, we were thwarted by deep sand and steep rocky terrain that defends the area. Our interest was sharpened when Ralph Jones—20 years a trader at the Kaibito Trading Post—told us that he knew of no one who had







▲ MEMORIALS to the power of falling rain and extremes of temperature. Fragments of the hard cap rock of the mesa, possibly fallen from cliffs in earlier times, protect the soft stone under them. Thus the caps remain balanced on ever-thinning columns.

◄ NO PLACE TO BE CAUGHT in a flash-flood! Eight to ten feet of water not infrequently roars down these canyons. A flat sandy bottom here made jeep travel possible, but elsewhere it was rough going on foot.

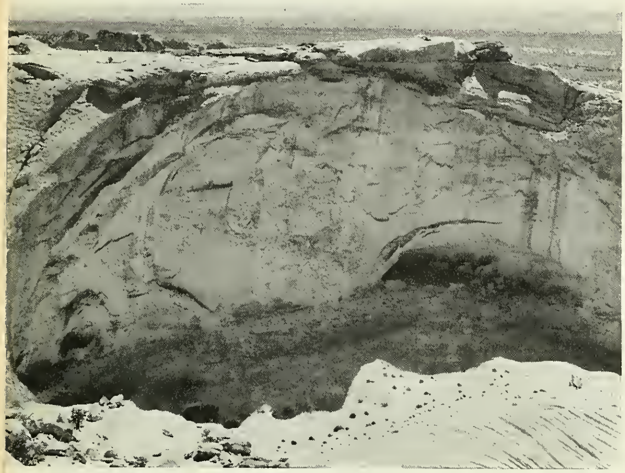
thoroughly explored the mesa. Except for one or two prominent landmarks visible from the road, none of its physiographic features were known. Ralph's nephew, Winfield Jones, had ventured into a couple of the canyons during summer sojourns at the trading post, but that was all.

White Mesa became a challenge to us.

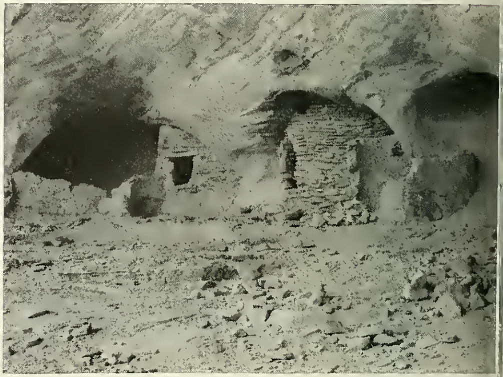
Three years ago we made a second attempt at penetration. This time, though our jeep was taxed to the utmost, we managed to break through the natural barriers to a canyon leading to the mesa. Once in this canyon, it was like driving up Broadway. The floor was sandy but level. Cliffs rose on either side like the crumbling walls of an ancient metropolis.

Our brief reconnaissance convinced us that more extensive exploration would be rewarding. Plans were laid for a three-week trip the following summer. The torrential rains we had encountered worried us. Narrow canyons draining nearly 100 square miles of land were no place to play tag with thunderstorms and flash-floods. Debris lodged high on the canyon walls and in the limbs of giant cottonwood trees showed clearly the depth of the torrents that had roared down the defiles. Having no desire to be added to the debris, we planned to make the trip as early in summer as possible, when rainfall is generally slight.

So it was early in June of 1953 that we once again knocked at the portals of White Mesa, armed this time with a set of aerial stereo-pho-

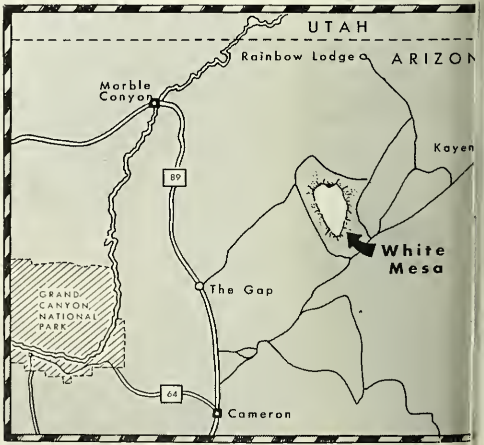


▲ **Towering cliffs and tiny homes.** Several large natural depressions in the rock on top of the promontory directly above the cave were no doubt used as a water supply for the ancient community.



▲ **Remnants of a vanished era.** These houses, occ pied centuries ago, were in sheltered grottos in th back wall of the large cave. The scene was once ga with activity. Cooking fires blazed, women were bus making clay pottery, weaving baskets, grinding cor or tending the children. The men worked on bows an arrows and made snares for catching animals. Far ing was the chief activity.

▼ **Natural reservoirs.** The large potholes atop the cliff were nearly four feet deep. Collectively they could hold several hundred gallons of rain water and may have served as the "City Waterworks" in an arid era.



▲ One of the impressive arches to be seen in the cliffs and abutments of White Mesa.

tographs. These pictures, studied through a pocket viewer, showed individual rocks, crannies, and even trees in three dimensions, and were to prove invaluable.

We learned how vital the 3-D photographs could be on one of our jeep trips into the complicated canyons at the base of the mesa. Winfield Jones was with us at the time, and in making room for three persons, we had unknowingly buried the stereo pictures at the bottom of our dunnage, on top of which one of us had to ride. We should have stopped and dug out the pictures, but we thought we could get along without them.

We followed a faint Navaho wagon track toward the mesa where certain landmarks looked familiar, but had to retreat to the road again to get our bearings. A second attempt looked more promising, for it took us into a large canyon we thought would lead into the one we were seeking. But after we negotiated several miles of rough, sandy country with a rising wind that caused the sand to fly, the walls on either side narrowed too close to let our jeep through. We had either to return over all those miles of sand in the face of the wind or go up the steep, rock slope.

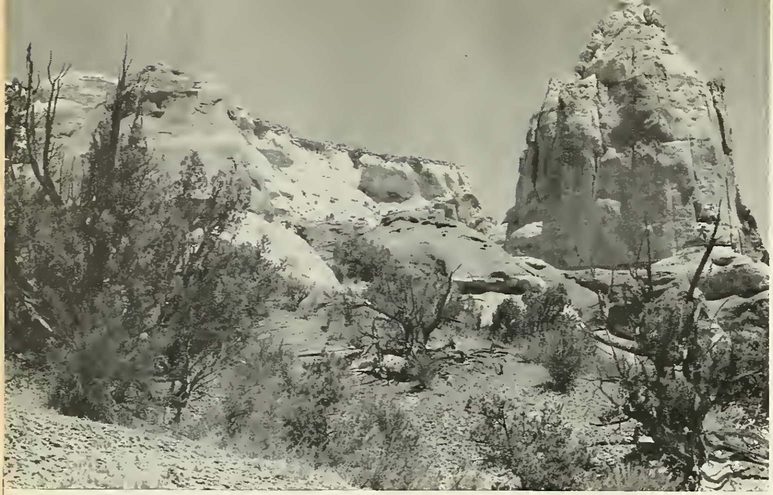
The jeep makes the grade

We measured the incline and found it to be 28 degrees—rather steep even for a jeep, when loaded as heavily as ours. After removing loose boulders and surveying the situation, we tried it, one man acting as guide and another piloting the jeep. We made it up the slope, but down in the canyon on the other side, more of the same kind of trouble could be seen ahead, so we followed another wagon track leading out of the canyon. Still another avenue took us through more rough country. Just when we were sure we were on the right track, we ran into our own tracks and were completely befuddled. So we stopped and dug out the aerial photographs. Soon we were on the right route into the main canyon.

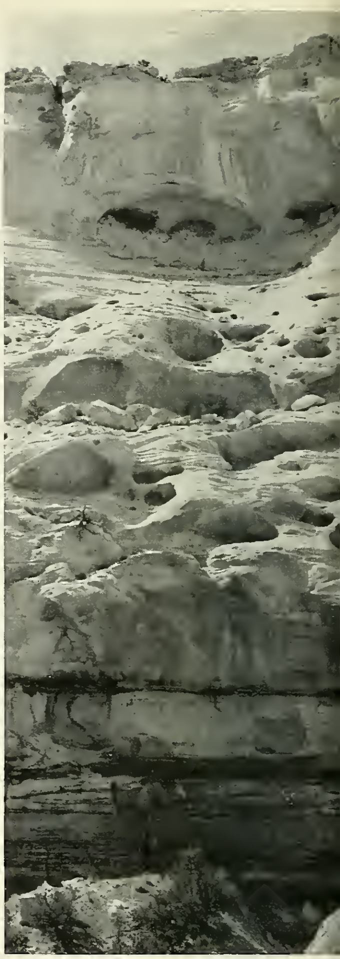
These photographs also provided a means of literally "pinpointing" the many geological formations and prehistoric ruins we found. We would prick through the photograph with a pin and beside the hole on the back of the picture identify the spot. These records are now on file with the Museum of Northern Arizona at Flagstaff, where they can be used by qualified archaeologists.

White Mesa is roughly heart-shaped, 8½ miles wide and 16 miles long, with its long axis running north and south. Many of the hills along the cliff are of soft sand, in which one slides back two feet for every three feet gained. When going down hill it is difficult not to start an avalanche. If that occurs, all that remains is to ride its crest to the bottom. But to avoid being buried when the avalanche piles up, one must become adept at sidestepping onto a rock or solid ground before reaching the bottom. It is always well, too, to know that a solid landing will be waiting—not the brink of a cliff.

When Helmut Abt and I finally reached the top of the mesa, we were surprised to see extensive sand



LOFTY HIDEAWAY. The cave high in the distance proved to be the site of ancient cliff dwellings. Now it is completely inaccessible. The close-up view at right shows that housing came high in those days, too. Twelve or more houses occupied this lofty perch. Most of the tons of rock and mortar required to build the dwellings had to be carried on the backs of the builders. All food and water also had to be transported to the dwellings. Time has apparently erased the only means of access.



dunes. Elsewhere, there was a fairly dense growth of juniper, piñon, sage, rabbit brush, cactus, and sparse grass.

Near the southern tip of the mesa we found something of a mystery. We went out on top of a thin fin of rock that projected out several hundred feet. At the fin's narrowest point, the cliffs plunged straight down for a hundred feet or more on each side. Just beyond this narrow neck lay the remains of a single, man-made rock wall. We puzzled over this relic for some time. In the cliff below, we had seen a cave containing ruins, and at first we thought this wall marked a position from which an enemy could be prevented from causing damage to the dwellings below. But investigation soon disclosed that it was not possible to hurl stones or shoot arrows from this spot onto the approach to the cliff village. There must have been some other purpose for that wall. At last we found what we believe to be the answer.

Eroded into the hard caprock of the fin were several large potholes that would have been a valuable source of rain-water to the people living in the cave below. The holes were nearly four feet deep and from two to three feet in diameter. To appreciate the importance of these natural tanks and to understand the necessity of a stone wall to protect them, one must go back 10 or 12 centuries.

The rains didn't come

Evidence indicates that this region was once blessed with a somewhat different climate than that now prevailing. Gentle rains fell, streams flowed through fertile valleys, and springs bubbled out in many places. It was in this hospitable country that the ancient Pueblo culture developed. There were occasional dry periods, but these were relatively short, and rainfall could be expected before crops were ruined. In the 13th century, conditions seem gradually to have changed. Less and less rain fell, streams and springs diminished or dried up altogether. Hot winds began to sweep across the country, withering vegetation. These hardships forced many of the ancient inhabitants to drift away. Finally, in 1276 A.D., according to tree-ring records, there began a period of 23 years when almost no rain fell. This completed the devastation. The large cave communities of Betatakin, Kiet Siel, Inscription House, and others, as well as communal pueblos to the east, were all abandoned. The few people remaining in this once large group of communities fled the area never to return.

During the early stages of the drought, otherwise peaceful people probably attempted by every means to provide for themselves. Only the most able—or the most ruthless—survived the rigors long enough to face the final tragic necessity of abandoning home and possibly even loved ones. Driven by thirst and starvation, the people may not even have had the strength to carry the aged and young with them on their final flight. Under such conditions, the occupants of the cave in the cliffs of White Mesa may have found it necessary to protect vigorously the little water that collected in the potholes on top of the cliff. The wall may well have been built to fend off raiders.

Winfield Jones joined us at one point to try to find a fresh water spring that a Navaho had once shown him. One evening we picked a camping spot well above a stream bed so that an unseasonable storm could not drown us. Fantastically sculptured cliffs towered overhead. One of us set up the gasoline stove on the hood of the jeep, unpacked the aluminum cooking kit, laid out the eating utensils, and got supper started. The other two set up the canvas cots, which would keep us out of reach of the little sand scorpions that love to share a sleeping bag with you. For our own water supply, we unstrapped one of several five-gallon cans from a special rack on the rear of the jeep, where we also carried our extra gasoline. A garbage pit was dug conveniently close to the "kitchen," and a campfire was prepared. In short order, we had set up housekeeping and supper was ready.

After a hearty meal, we sat around the fire for awhile, but when the sky was barely dark, the attraction of our sleeping bags won out, and we settled ourselves for the night.

Next morning, we went up one of the many tributary canyons and soon encountered damp sand along the bottom. Presently we turned a corner and were face to face with a huge rock-fall that blocked the canyon for all but foot travel. An overhanging ledge at this point left only a narrow slit of sky, and deep shadows helped to make the place cool and refreshing. We scrambled over the rock pile and climbed on up the canyon.

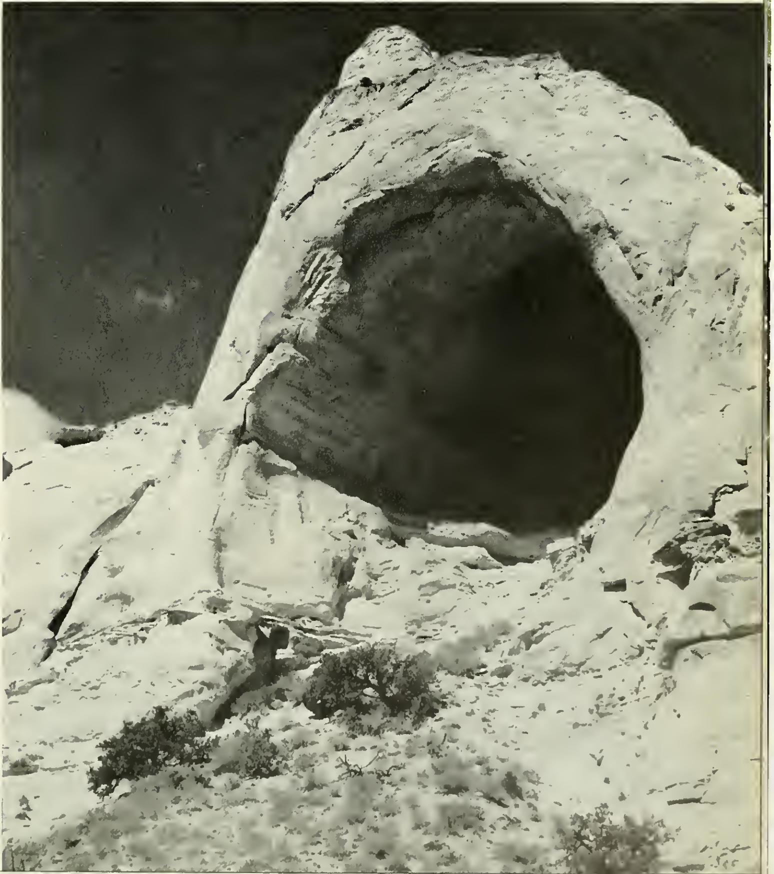
After going only a short distance, the canyon appeared to end in a vertical wall. When we got close, we saw that this originally had been a real box canyon but that at some time in the past a large sandslide had fallen, cascading over the brink and providing a steep path out of the gorge. Part way up this slide, in a grotto in the canyon wall, we found the spring. The modern Indians had improved it by walling up the recess so as to leave only a small door, and they had provided a short pipe to let the water out into a watering trough for their animals.

A rewarding struggle

Having refreshed ourselves on the cool sweet water, we tackled the sandslide to gain the level above. The slope was so steep and the sand so soft that it was a struggle to reach the top. But once there, we saw something that took all thoughts from aching legs.

A short distance above us on a rocky promontory was a ruin of rather late Pueblo architecture. We were not long in reaching what had once been a four- or five-room house. It was built of well-selected slabs of rock, with small chips for chinking. Traces of adobe mortar were still visible in some of the recesses. The flat expanse at the very tip of the promontory seemed to have been encircled by a low stone wall forming a courtyard. Below the level of the house, in several crevices in the cliff, were remnants of small storage crypts. There were so few fragments of pottery on the slopes around the ruin that we concluded the spot had been occupied only briefly.

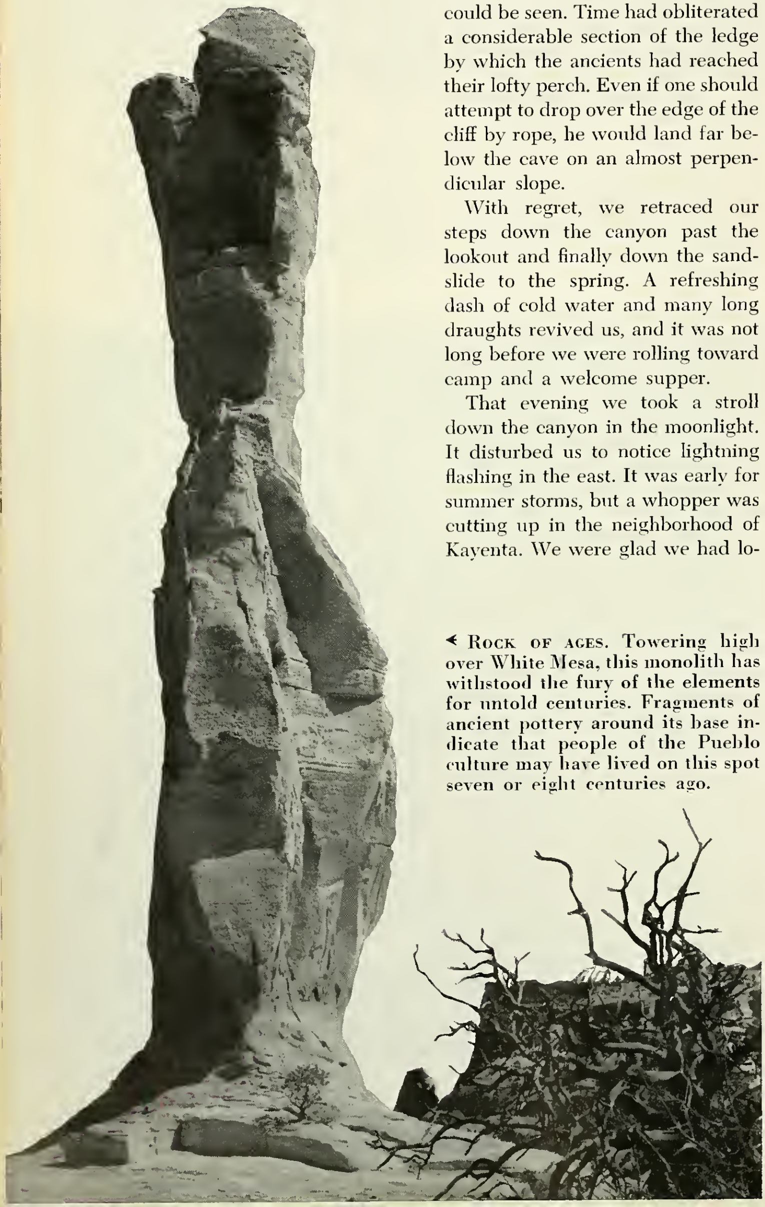
Whoever had chosen this pro-



➤ ONCE A THRIVING VILLAGE occupied the mouth of this cave. Fires twinkled and happy voices could be heard among the stone houses. Now the cave stands silent and empty.

montory as the site for a house either had an eye for scenery or wanted to be sure to see any visitor approaching the spring in the canyon below. This may indeed have been a lookout or guard station in those last desperate days of drought when every drop of water had to be guarded.

Farther up the canyon, we reached a point where a huge pinnacle of rock towered into the air. Just below the brow of the cliffs behind this monolith was a cave, in which our binoculars showed a group of ruins. The cliffs below were almost perpendicular. We could see no possible way to reach the cave.



We went up the canyon to inspect the place from another angle, but all routes were too dangerous to follow. We scaled the cliffs on the opposite side of the canyon and again examined the ruins with the binoculars. Still no means of access could be seen. Time had obliterated a considerable section of the ledge by which the ancients had reached their lofty perch. Even if one should attempt to drop over the edge of the cliff by rope, he would land far below the cave on an almost perpendicular slope.

With regret, we retraced our steps down the canyon past the lookout and finally down the sandslide to the spring. A refreshing dash of cold water and many long draughts revived us, and it was not long before we were rolling toward camp and a welcome supper.

That evening we took a stroll down the canyon in the moonlight. It disturbed us to notice lightning flashing in the east. It was early for summer storms, but a whopper was cutting up in the neighborhood of Kayenta. We were glad we had located our camp on a raised piece of land.

◄ **Rock of ages.** Towering high over White Mesa, this monolith has withstood the fury of the elements for untold centuries. Fragments of ancient pottery around its base indicate that people of the Pueblo culture may have lived on this spot seven or eight centuries ago.

Concluding that the cloudless sky promised fair weather for our area, we dozed off. But it seemed only minutes before we were awakened by the spatter of rain on our faces. We piled out to cover the beds with waterproof material and protect the equipment. The jeep was soon battened down under a heavy tarpaulin. Then we stopped to survey the extent of the impending storm. The sky was clear and the stars shining brightly! One small cloud was rapidly vanishing in the west. Disgustedly, we got back into bed and slept peacefully until the bright sun awoke us in the morning.

We hastened through the camp chores (if consuming large quantities of pancakes, bacon, eggs, and coffee constitutes a chore) and started out once more, anxious to examine some large caves we had spotted on the stereo photos. We had visions of their sheltering large communities of ruins. Leaving the jeep in the shade of the cliffs, we began a detailed examination of the country. Checking occasionally with the aerial photos, we finally reached the caves. They were large all right, some with roofs towering 200 feet above us. But they were so shallow that they offered no protection, and no self-respecting Pueblo Indian would have considered them suitable for a home. So we passed the morning exploring the labyrinthian canyons, some of which were so narrow that we could hardly squeeze through. Sometimes the cliffs rose unbroken for several hundred feet over our heads, and we marveled at the fantastic shapes that had been sculptured in the soft stone. No camera gives a wide enough view to capture the magnitude and majesty of such scenes.

When Win Jones had to go back, one of us drove him out of the canyons to the Kaibito Trading Post while the other remained at camp to work on maps and reports.

On the eastern side of the mesa, we found a large cave framed by a lofty arch. It looked from a distance like the entrance to a tunnel into

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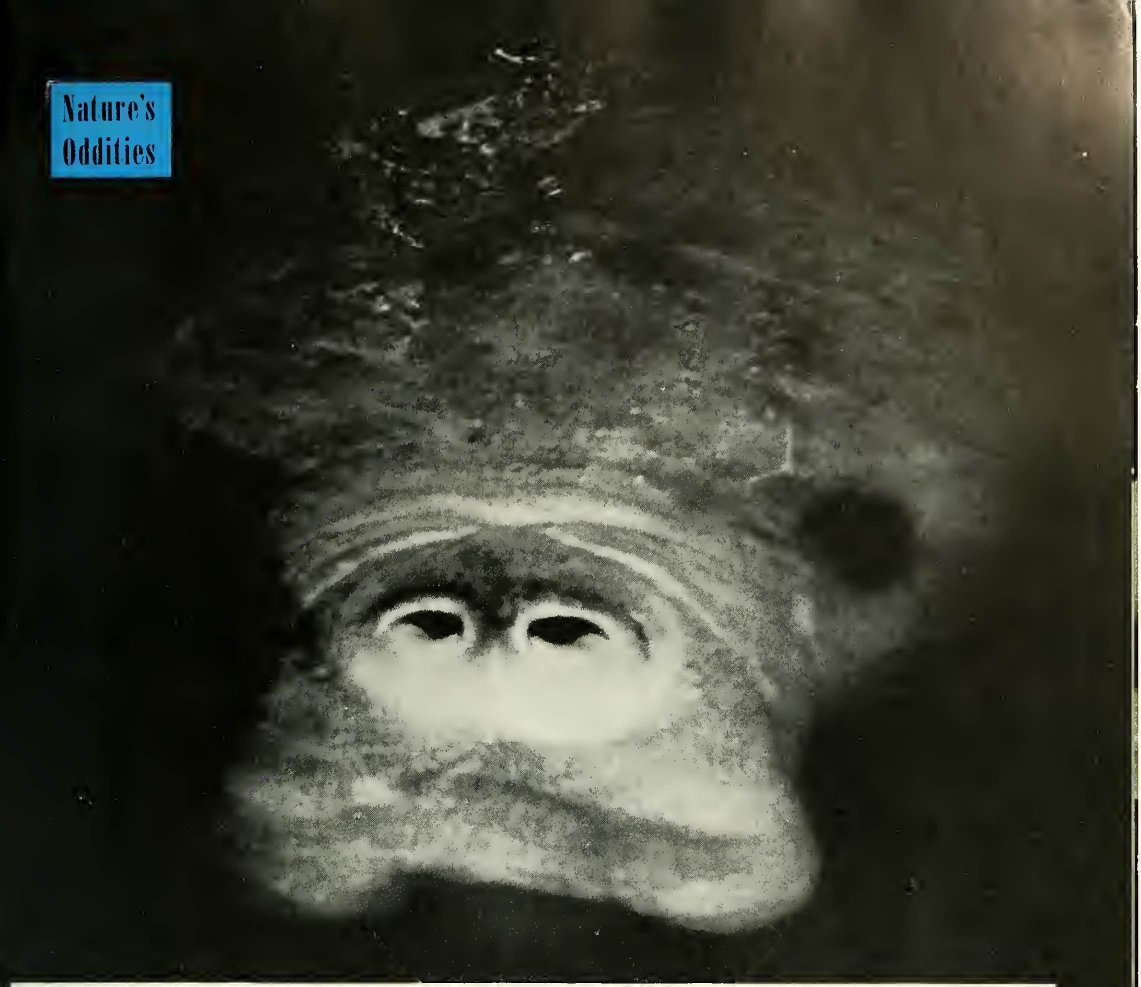


▲ LIKE ALL AQUATIC MAMMALS, manatees must come to the surface to breathe. When they occasionally venture into deeper water, they are said to float, with the back arched, the head, flippers, and tail hanging downward.

Grazers of the Sea

Though seacows are gross, sluggish, and clumsy, some men called them lovely

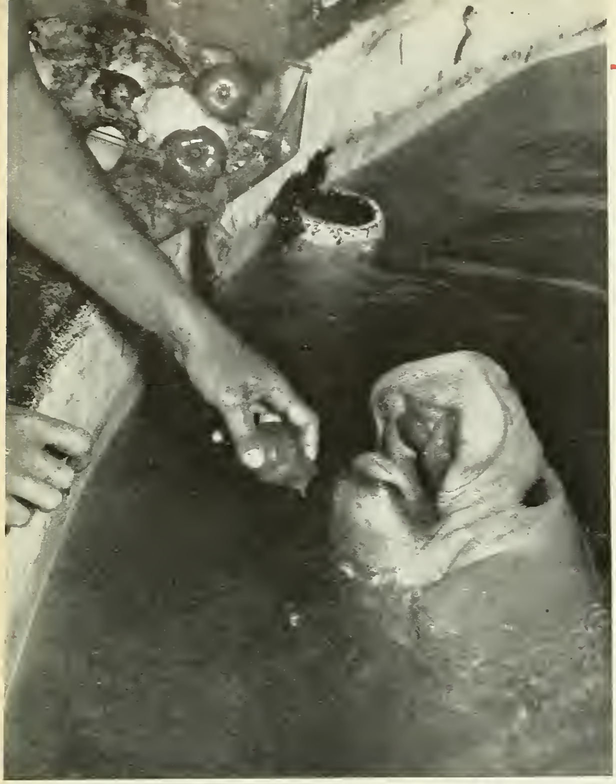
A photo series by KURT SEVERIN

THE pictures accompanying this article are ample proof that sailors have wild imaginations.

It is generally believed that close relatives of the unlovely creatures shown here inspired generations of seafarers to glowing tales of "mermaids" in the briny deep.

To men of discernment, in broad daylight, their descriptions were hardly appropriate.

These animals, commonly known as seacows, are Florida Manatees (*Trichecus latirostris*) and inhabit warm waters off our southern coast. The sailors' "mermaids" were probably dugongs, which are very similar in appearance and live in the



◂ THE MALE MANATEE opens wide for a tomato. An unusual feature of this animal is that it can move each half of its cleft upper lip independently, or compress both halves simultaneously in a manner suggesting the way a caterpillar uses its mandibles. Thus it can introduce food into its mouth without using the lower lip. Though this picture makes it seem impossible, the manatee has from 32 to 52 teeth, mostly grinding molars, far back in its mouth.

▾ THE FEMALE MANATEE (left) was captured and introduced to the male in hopes that an offspring would be born in captivity.

Red Sea, Indian Ocean, and waters off Australia.

The male and female pictured here are captives at the Sea Zoo in South Daytona, Fla., and have been nicknamed Winston (for Churchill) and Gracie. Both were captured off the Florida coast.

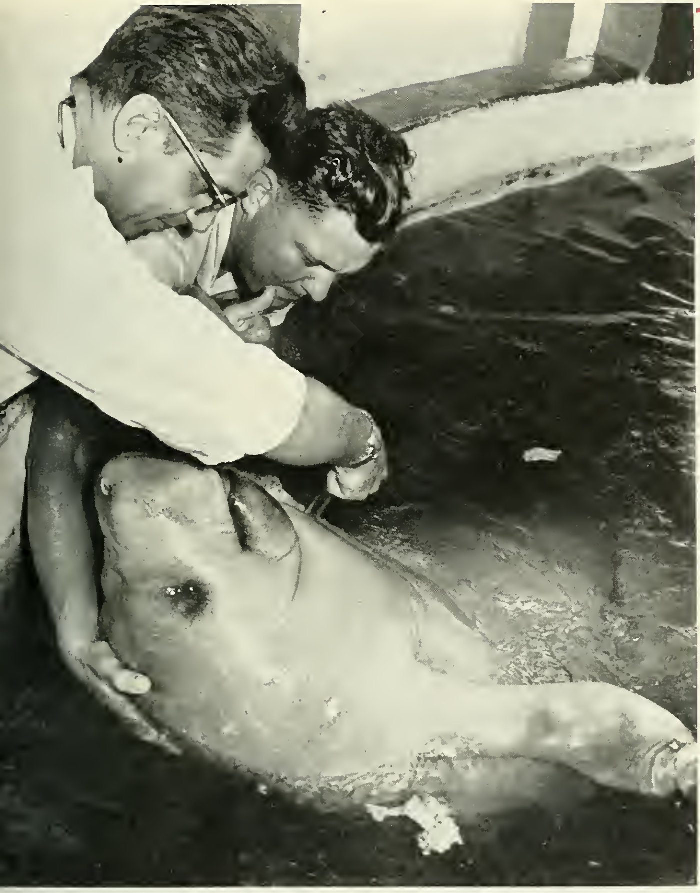
Seacows differ markedly from seals and walruses in that they have no hind flippers, are confined to tropic shallows, and, instead of eating fish, dine exclusively on aquatic plants. They are almost helpless on land.

Winston, the male manatee, is of unknown age, but has been in captivity more than three years. When taken, he weighed about 350 pounds and was 6 feet 6 inches long; now, he weighs about 850 pounds and is slightly over 8 feet long. Eventually he may gross almost a ton. His daily diet consists of about 175 pounds of fruits and vegetables, and he devours potatoes, bananas, lettuce, tomatoes and honeydew melons with obvious relish. Onions he doesn't like.

Surprisingly responsive

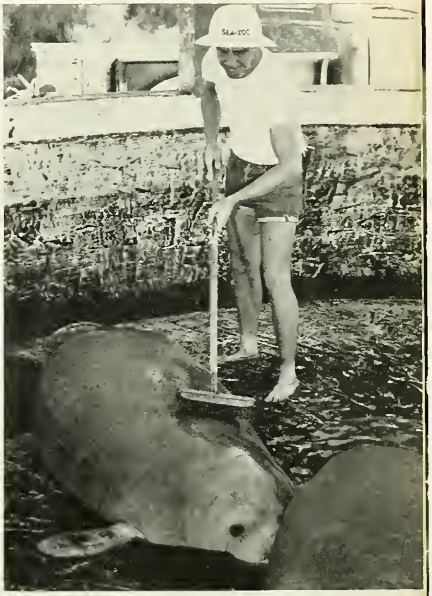
The huge vegetarian has become very responsive to his keeper; likes to be petted; will come when called, and is said to obey simple commands like "Roll over" and "Shake hands."

Like all members of the order Sirenia (manatees and dugongs), Winston is subject to colds. When he contracted pneumonia not long ago, the Sea Zoo's family physician, Dr. Perry A. Sperber, had to use three million units of penicillin to cure him. The pool temperature is maintained at 70° F., and any temperature below 60° F. would endanger the animals. (Killing frosts that sometimes play havoc with Florida citrus groves also take their



◂ Dr. Perry Sperber gives the 850-pound male manatee an injection to ward off the frequent infections to which the huge animal is susceptible.

▾ Without water to swim in, the manatee is almost helpless. Some observers state that it occasionally comes on shore to feed, but its puny flippers and whale-like afterbody would seem to make this extremely difficult.



toll from the manatee population).

The fact that Sirenians cannot live in cool or cold water has long been a puzzle to scientists. Various closely related members of the order are scattered widely over the earth (Florida, the West Indies, South America, Africa, and Australia), and insurmountable barriers for Sirenians exist between these areas today. How they were dispersed is the question. It must have happened long ago.

Almost everyone would agree that these grotesque animals look like something left over from the dim past. Their ugliness, however, apparently doesn't dampen their emotional urges. When the female manatee shown here was acquired to keep Winston company, a young manatee was captured at the same time. The sea "calf" came to a tragic end when all three were put in the same tank. Winston, exhibiting what appeared to be the rage of a jealous suitor, actually beat the little one to death.

Protected by law

Florida law prohibits retention of manatees except for scientific purposes. Representatives of the Sea Zoo had to obtain permission from the county and state before they could capture either of the animals, and, to fulfill their scientific obligations, have compiled data on habits, feeding, intelligence, disease resistance, and growth.

The female was acquired to see if manatees can be bred in captivity. If mating is consummated, she will produce a single calf and should be an extremely solicitous mother — a definite characteristic of her kind.

Winston, no doubt, will be placed in solitary confinement.

Guided Tours NOW COME IN BOXES

The newest thing in museum education is a portable radio receiver that takes you on a personal tour—and adds sound effects

By William A. Burns
Assistant to the Director
American Museum of Natural History

If you should drop into the American Museum of Natural History in New York City one of these days, you would see visitors walking about the exhibition halls wearing a gray crackle-finish box over one shoulder, an earphone on one ear and a rapt expression on their faces. Ask at any information desk and you'll find that they are wearing a Guide-a-Phone, one of the most revolutionary devices for museum education and entertainment that has yet been developed.

The Guide-a-Phone enables museum visitors to hear carefully prepared lectures about the groups as they walk around the exhibits. As each hall talk progresses, the soft sound of a bell in the ear tells visitors when to move to the next group. At the end of the tour, which takes twenty minutes in each hall, the talk begins again for new users of the instrument or for those who may have missed the first part.

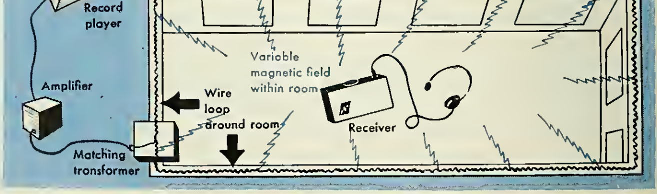
The history of this new departure in museum presentation began when one of the American Museum's trustees, W. Douglas Burden, was visiting Holland in 1953. In a small art museum in Amsterdam, he saw people standing before paintings, wearing what looked like hearing aids. He questioned a museum attendant and found that the art museum had co-operated with the Philips Company, the "Westinghouse" of Europe, in an experiment to explain paintings without the use of loudspeakers or a human guide.

The trustee saw possibilities in the idea for his own museum and wrote back home. American Museum people wrote to Holland for details, received them, and began experiments to perfect the instrument. In April, 1954, the first demonstration was held and the Guide-a-Phone was introduced to the American public for the first time in the Western Hemisphere.

The Guide-a-Phone is actually a tiny radio receiver, housed in an aluminum case that weighs less than a pound. The exhibition halls equipped for its use each contain a closed wire loop that acts as an aerial. Recordings of the lectures are played from a centrally located control room, the electrical impulses are carried to the hall and broadcast from the wire loop. The receiver picks up the impulses, amplifies them, and the visitor hears the talk through a single earphone.

Recently, the sounds of nature have been added to the lectures. You can now hear the roll of Pacific surf on a coral atoll, the screaming of sea birds on Great Barrier Reef, the roars and coughs of a family of lions, the trumpetings of African and Indian elephants, the cry of a puma, the gurgling of a New Hampshire brook, the sounds of a Georgia swamp at midnight, the shrill whistle of an Arctic blizzard, and many other background effects that

How it works. Flawlessly prepared lecture-recordings, enriched with nature's noises, are channeled from a central control room to closed-wire loops surrounding museum halls, and thence transmitted to Guide-a-Phones worn by visitors.



add considerably to the lectures.

This has had a pronounced effect on the visiting and listening public. One of the problems of museum people has always been labeling exhibits. Studies on the amount of time that people spend in reading labels show that from five to twenty seconds is average reading time. This has at times been disheartening to museum people who have combined their scientific or artistic talents with those of professional writers to produce an informative label for an exhibit.

The Guide-a-Phone cannot take the place of the museum label, but it can be used as a supplementary device to make the assimilation of information about museum exhibits much more profitable and enjoyable than ever before.

The response of the museum-going public has been instantaneous and enthusiastic. Hundreds of comments have been received, praising the device — "Absolutely the first time I ever enjoyed a visit to a museum," "A new avenue for layman's information," "An exciting technique," and many, many others in like vein.

Perhaps the most touching is the reaction of a man who is now totally blind. He said, "Although I can no longer see the museum groups, the Guide-a-Phone, with its words and its sounds, is so graphic that it was like having my eyes again."

Five exhibition halls have been equipped with the Guide-a-Phone — South Pacific Birds, North American Mammals, Ecology, African Mammals, and the Brontosaur Hall. Additional halls will be equipped in the near future.

Further plans include the possibility of using multiple frequencies so that a Frenchman, an Englishman and a Spaniard can all stand side by side and hear the lecture, each in his own language. Another use of multiple frequency broadcasting is to stagger the talks around each hall so that three separate groups of visitors can go around instead of one over-crowded group.

Since its introduction at the American Museum, the device has attracted the attention of other museums in both North and South America, and of people in commerce and industry, who see in it a new and effective way to describe their products at shows and conferences.

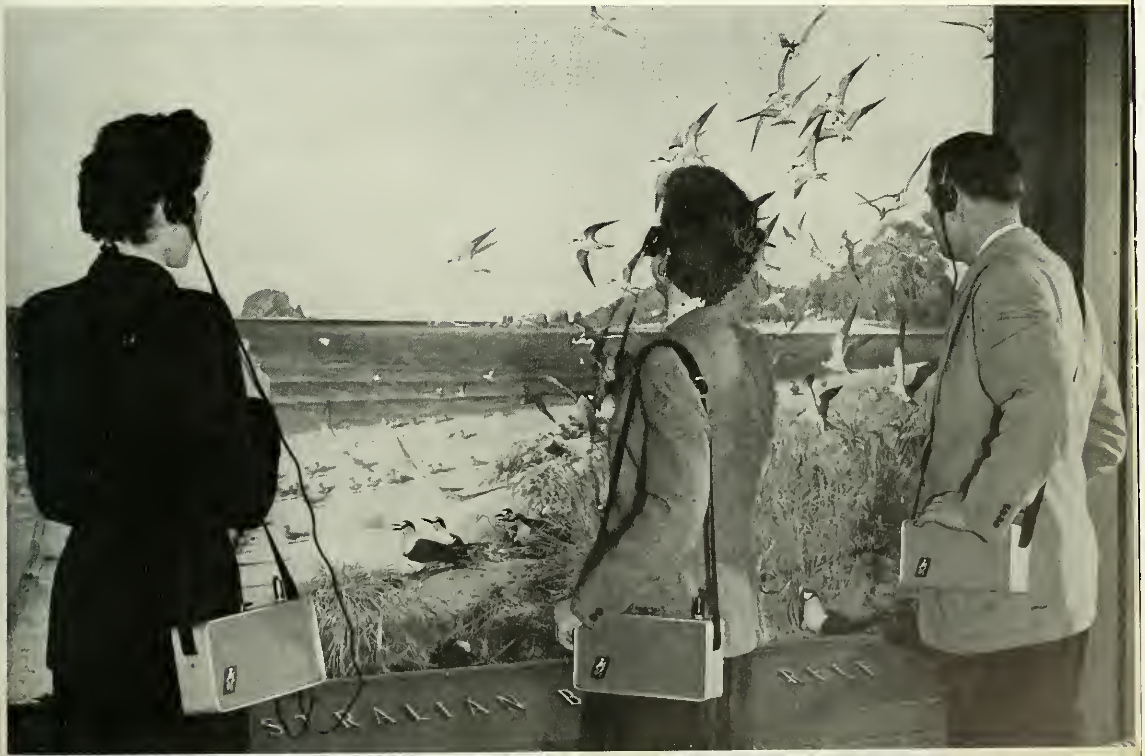
The Guide-a-Phone was purposely made too large to fit into an overcoat pocket. Of the 125 instruments in the original installation, only three have disappeared. Two were stolen outright, and the third was smuggled out of the museum by two little boys who took it apart in Central Park and then threw the pieces into the lake in panic.

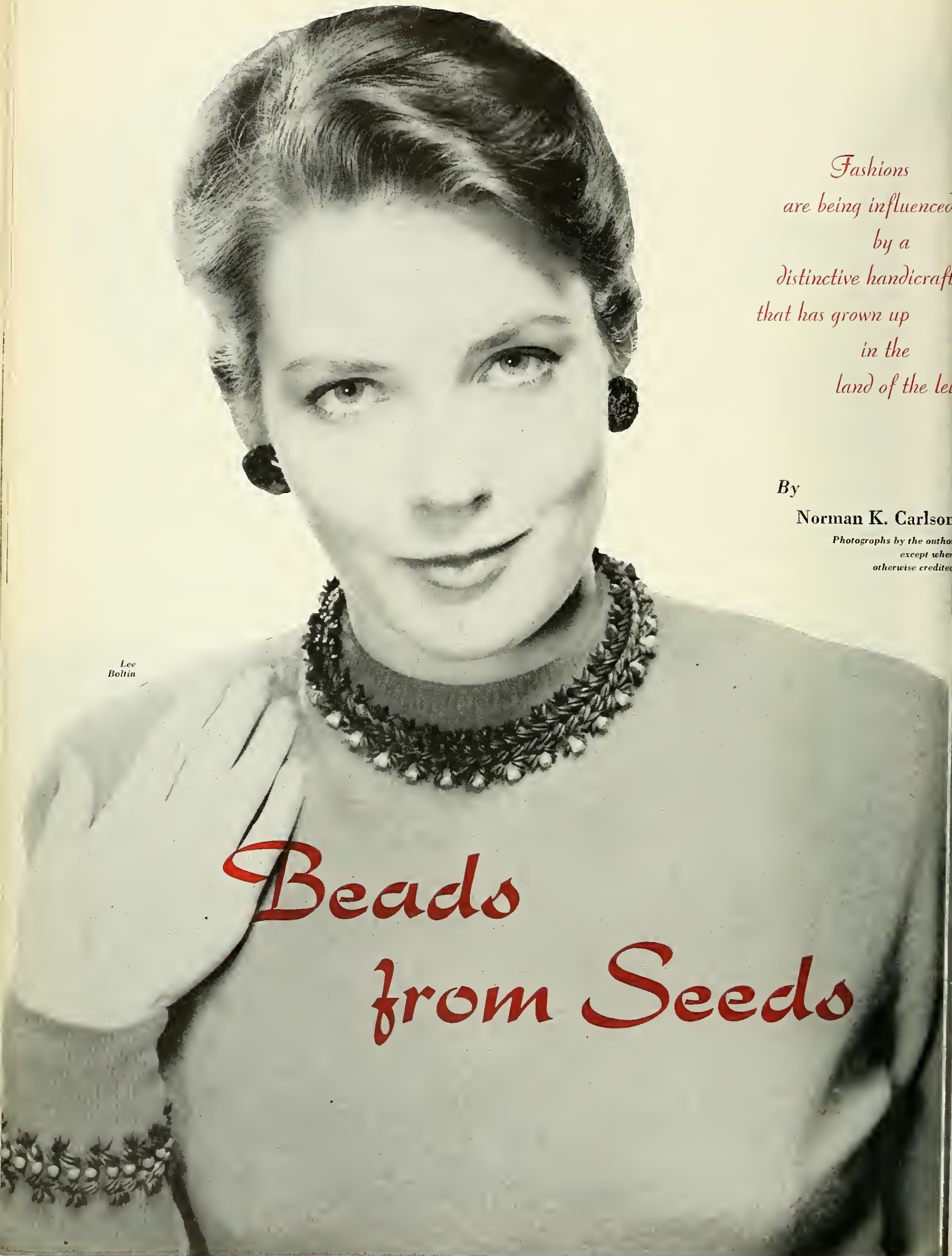
Only one adverse comment has been received by the museum and that from a discerning school boy, who summed up a weakness characteristic of any mechanical teaching method.

"I enjoyed it," he said, "but you can't ask a Guide-a-Phone any questions!"

▼ THREE MUSEUM VISITORS, equipped with GUIDE-A-PHONES, take in the sights and sounds of bird life on Australia's Great Barrier Reef.

AMNH





Lee Boltin

Fashions
are being influenced
by a
distinctive handicraft
that has grown up
in the
land of the lei

Beads from Seeds

By

Norman K. Carlson

Photographs by the autho
except wher
otherwise credite

◄ **It takes** the patience of Job to collect a basketful of seeds from the plant known as Job's tears. But they make fine beads. A scene on the fertile, rain-drenched lands of Kona.

▲ **Each stem** of the Job's tears plant bears many ivory jewels, which must be plucked separately.

In Hawaii, where the necklace of flowers has long been a symbol of friendliness, it is natural that seeds should find expression in similar adornment. The lei of seeds may never supersede the wreath of flowers, but it does have the advantage of long life. So seed necklaces made in Hawaii are now being shipped abroad and finding service as everyday wear in other lands.

On the side of Kealakekua Bay, on the coffee coast of Hawaii, is a little village called Napoopoo. Time passes slowly there. It has a tiny post office and one small store. Yet, 100 years ago, whaling ships rode at anchor in the harbor through the winter, and life was exciting. A wharf was built, and most of the traffic of the coffee district of Kona passed through the little city. Now, the settlement has been bypassed by another port, and the almost deserted wharf is used by only a few fishermen. But fortunately for Napoopoo, this spot is a "must" for the traveler, for it is picturesque and is near the place where Captain Cook carved his niche in history.

Here, a few years ago, in the wasting hours, the womenfolk started to make leis out of seeds. They sold a few. As time slipped by, beads from seeds became a profitable sideline for some of the people of Napoopoo. They found it pleasant to sit under the twisted *opiuma* tree, selling necklaces to the tourists and talking away the warm afternoon.

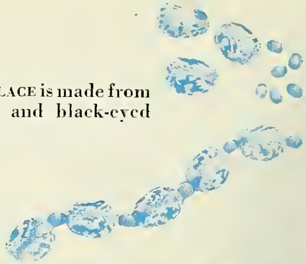
One morning, while surveying Kona's lands, I stumbled through a thicket of *pu'ohe'ohe*, which in English is called "Job's tears." Here the soil was damp and deep, and the plants were heavy with half-inch oval seeds that crowded the ends of the seven-foot stems. Some were green, some brown, and the ripe ones were ivory-colored.

I noted the abundance of choice seeds — and the steepness of the land. There is no cultivation here, nor are the cattle allowed to graze. The rains can be torrential, and there is a nagging danger of destruction; a deluge of muddy water on the coffee lands below would be disastrous. The *pu'ohe'ohe* is an excellent plant for controlling erosion, though it is a pest when it sneaks into the coffee orchards below. Picking the seeds does not lessen the plant's effectiveness in holding the soil in place.

I told the lei sellers of these seeds, and they wanted to harvest them. A week later, on a Saturday morning, I drove to Napoopoo. Waiting for me were the Gaspars, the Leslies, the Perkinses, and the Pakikos.

We drove through the dry low-

Lee Boltin



◄ THIS NECKLACE is made from castor beans and black-eyed susans.

▲ WITH a 3/64th-inch drill point, a hole is quickly bored. This is a kakalaioa seed, a kind large enough to handle easily with the drill.

◄ A NEEDLE easily pierces the Job's tears through the softer ends, though the rest of the seed is tough.

▲ IT IS PLEASANT under the gnarled opiuma tree on a warm sunny afternoon.

lands, thick with thorny opiuma, then among the coffee orchards, and finally into the wild lands covered with brushy guava, umbrella-like ti plants, and green, fast-growing grass. We left the car at an old bridge, walked a bit, climbed through a banana grove, stumbled past fruit-laden avocado trees, and out onto a steep grassy slope. Nodding stalks of Job's tears covered about half an acre.

All morning the women and children picked the ivory seeds, dropping them into little baskets tied to their waists. Since from 6 to 20 seeds range along the tips of the stalks and have to be picked separately, gathering the seeds of Job's tears requires the patience of Job. I soon lost interest and left.

Almost every spring afternoon on the upper lands of the Kona coast, clouds roll down the slopes. A gentle rain keeps the hills a radiant green and waters the thirsty coffee trees. This day was no exception. When I went back up, the Napoopoo folk had finished picking and were eating lunch on the decrepit bridge. The slow-falling rain bothered them not at all. For each one had gained a little sack of ivory seeds.

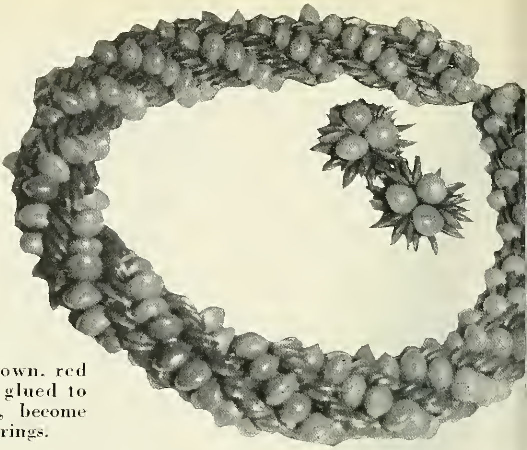
Other "wild" beads

About two dozen other plants also provide seeds for the jewelry that bewitches the traveler and the *kamaaina* (old-timer) alike; but most of the plant jewels are even harder to collect than Job's tears. *Ka'e'e'e* is an example. It is also called "goat's eye," and the description is apt, for across the dark, olive-colored seed is a band of black that resembles the iris of a goat's eye. It grows from 500 to 2000 feet above sea level in the rain-drenched wild lands. The *ka'e'e'e* vines are hundreds of feet long. Up the trees and over the large brush plants they scramble, and hang down on all sides like a canopy. They almost smother their support. The flowers and the fat seed pods usually hang from a height that discourages the collector.

The seeds ripen in large, prickly drooping pods, somewhat resembling a bat at rest. When the bristly shell opens, one to three seeds fall to the ground. Sometimes, the rains carry the tough-hided kernels down the little streams and into the sea, to be washed up on the shore miles away; so another name for this plant is "sea bean."

The collector can gather goat's eyes by wearing heavy leather gloves and picking the pods from

AMNH



◀ SEEDS (brown, red and ivory), glued to plastic disks, become attractive earrings.

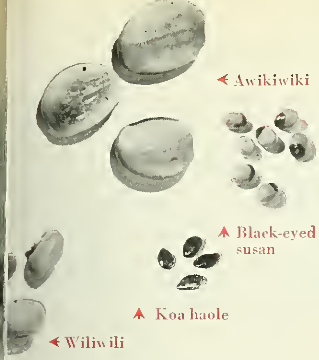
▼ WITH A FLOWER in her hair and a blossom in her hand, Yvette sits before a rack heavy with bead necklaces.

the vine. Soaking the pods in a bucket of water for a few days softens them; then a broom handle readily works the seeds loose.

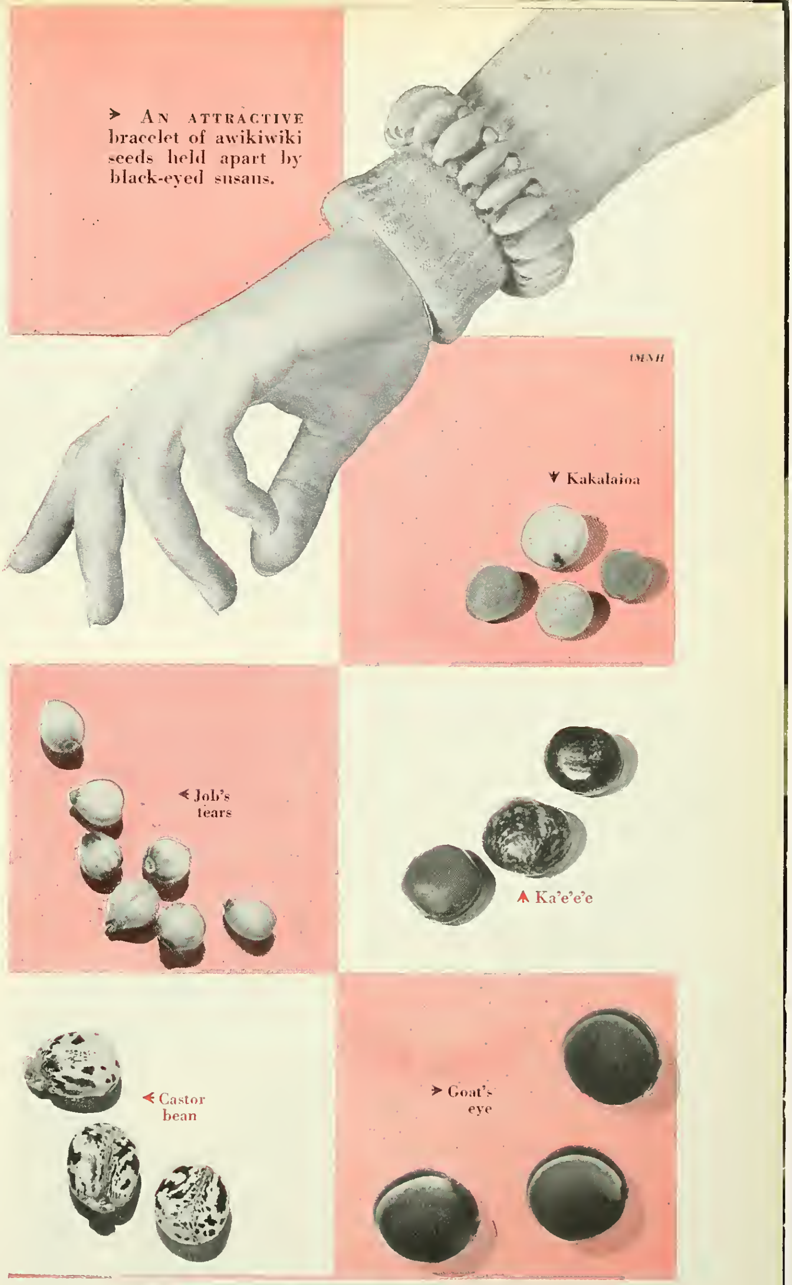
The red sandalwood tree produces what are called false wiliwili seeds. This introduced tree has a long straight trunk and an umbrella of one- to two-inch oblong leaves. After the flowers bloom, pods form, split open, and curl back, and some of the brilliant scarlet beans fall. Impatient collectors knock the little pods down with sticks and stones.

The newcomer to Hawaii has no trouble in learning to know the black-eyed susan, though it is not the same as the North American flower by that name. A black spot shines in the center of the quarter-inch, brilliant red seed or bean. Here and there, in the half-dry half-wet sections of Kona, this vine scrambles up the trees, clinging to and almost choking the life out of its benefactor. Its seeds are avidly sought, and the location of a colony remains the secret of the lucky finder. Few know that the kernel is poisonous; if the seed is broken and a bit of the meat gets into the bloodstream — be careful!

The *kukui* or candlenut tree is a true Hawaiian species. Pale yellowish green colonies of this tree are splashed against the vivid green hills. Under these trees, the ground is usually very rocky, and kukui nuts



HIS CHOKER is made from seeds and false wiliwili s. The earrings match. g of same combination.



AN ATTRACTIVE bracelet of awikiwiki seeds held apart by black-eyed susans.

are scattered all through the rocks. A tree may drop 100 pounds of nuts in a season. Inside the furry green husk is a hard-coated shell. These rock-like, two-inch nuts can be polished into handsome gems. Strings of them are quite expensive and very beautiful. The meat of these nuts is extremely high in oil content and was once used as a source of fuel for the torches of the Hawaiians. But when they are used as beads, the meat must be cleaned out, else the oil will stain. Ants do the job.

Beauty from a pest

The pesky *opiuma* tree has a single virtue: it does furnish seeds for leis. They are a nuisance to shell. This tree came to Kona half a century ago and has become a pest. So far as is known, the wood is worthless. The leaves are not eaten by the cattle. Its thorns are wicked, and the limber branches almost go out of their way to take the shirt off a man's back and gouge his skin. The folk of Kona would willingly trade this tree for almost any other, but it supplies them with a seemingly never-ending source of seeds. The seeds are enmeshed in a cottony mass in a curled pod.

Botanists are not yet sure whether the *awikiwiki* is a native plant of Kona or not. The lei sellers call it *mamaloa*, a name applied to many Hawaiian seeds and plants. The awikiwiki vine sprawls all over its upright neighbors. Its flowers, resembling sweet peas, bloom in June and July. By the end of August, in a dry year, the pods are dry. A machete usually is needed to cut through the thorny lantana to get to the seed pods. The thin envelopes invariably hang just out of reach, and a hook must be used to bring them to hand.

From each region in the islands, there are seeds that the lei makers prize. Soapseed comes from Bird Park in the Hawaiian National Park, a type of ka'e'e'e from Hilo; Thomas Square in downtown Honolulu has the false wiliwili seed. Then there are canna seeds, two kinds of castor beans, ka'e'e'e of many varieties, and other tongue-twisters.

After the seeds are collected, the lei maker needs patience, a sure hand, and an artistic faculty. First, the wicker baskets of seeds are sorted. The poor and off-colored ones are thrown away. Then out comes a quarter-inch electric drill, and its powerful little motor whirls the 3/64th-inch drill point through the seed. A drill with a long cable may be used when working on small seeds. The electric motor is controlled by a foot switch or rheostat. Drilling a hole through a black-eyed susan bean held between the fingers calls for a steady hand and a sure eye. Sometimes a finger gets nicked. A few plants, such as Job's tears, have seeds that need not be drilled, for a needle can easily be pushed through. *Kao haole* seeds are tough-hided, but boiling them for 10 minutes or so softens the tough outer coat so that they too can be threaded with a needle.

After the *pukas* (holes) are made, various combinations of maunaloa, wiliwili, and other seeds are strung on #12, four-cord, black, left-twist, glace finish cotton thread. A larger or a double thread is used where the necklace is tied, or when using large and heavy seeds.

The clasp? The string can simply be tied. A couple of goat's eyes make a handsome end of a loop. But most of the leis have metal clasps bought from hobby shops on the mainland.

After stringing them, some folk coat the leis or necklaces with a plastic material, a clear shellac or enamel, or colorless nail polish.

Enchanting earrings are made from the various seeds. The folk buy the ear clasps by the hundreds and on the flat disks assemble the seeds, securing them with a good cement. Or they may string an arrangement and then mount the circlet with a long-lasting adhesive. Bright bits of seashells gathered from the beaches add an eye-catching appeal. A pair of earrings usually sells for less than a dollar, tax included. Belts, hat bands, bracelets, and chokers are displayed on the little tables.

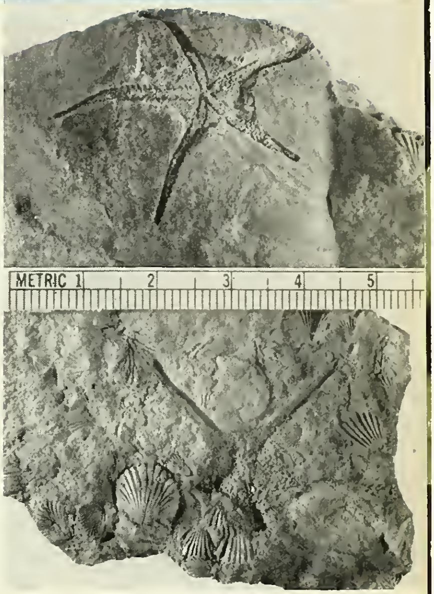
The seed lei is seen in almost every little shop in Hawaii. At the airports and the jewelry counters, the assortment of beads is as varied as the artistic and imaginative sense of the people. It is not a big business, though it is a profitable side line for many folk.

Now and then the children of Napoopoo, who like to spend their free time under the big tree, make flower leis. These short-lived, sweet-scented necklaces are hung around the tourist's neck, and a kiss may be dropped on the cheek of the *malihini* (newcomer), "Hawaiian style." If the day is cool and the mood right, the children hula and sing some of the old songs.

The folk of Napoopoo will never get rich from the lei business. Still, it is a pleasant pastime. It requires a good knowledge of plant habits, a steady hand, an artistic sense, a drill, some string, a few clasps, a bottle of shellac, an assortment of seeds, an unusually large chunk of patience, and a certain warmth of heart. All this goes into the beautiful seed lei. Is it any wonder it reminds you of Hawaii every time you look at it?

◀ MRS. SUSY KALUA straightens up her display of bead jewelry, which the trade winds blow out of arrangement.

Roadcut (left) where fossil starfish were found is near Cooperstown, N. Y. Directly below is a fossil specimen of *Protaster logani;* at bottom is what is believed to be a new genus and species.



300-million-year-old Starfishes

Ancient "sea-creepers," new to science, found in their graves far from the coast

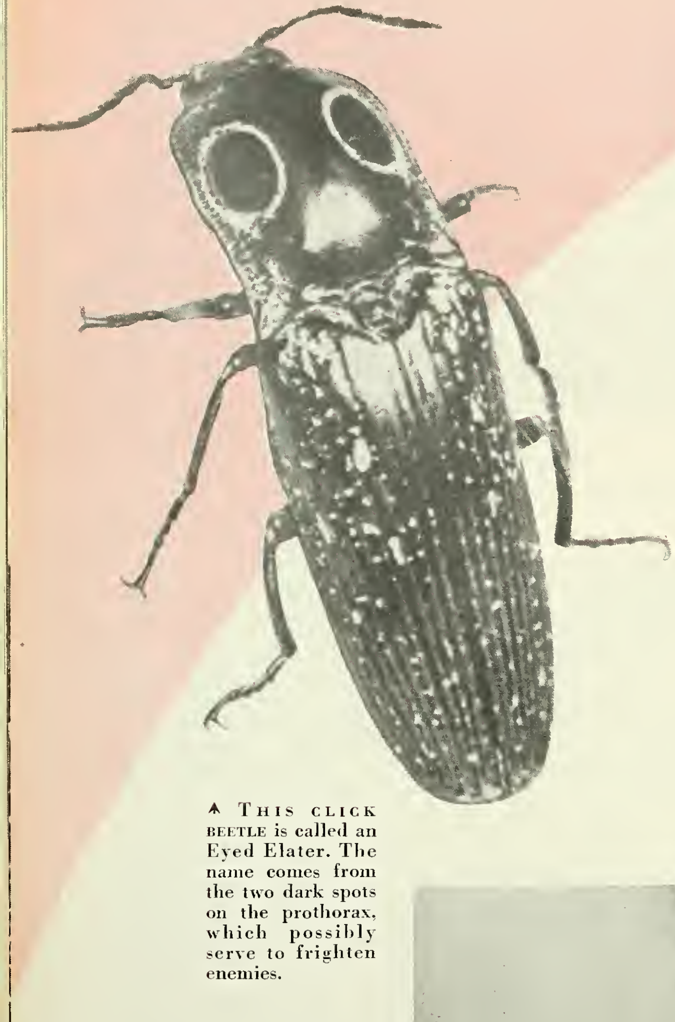
By Monroe A. *and* Elizabeth P. McIver

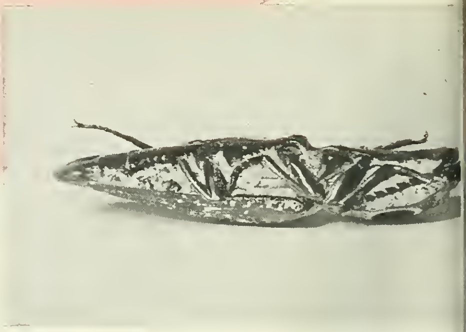
When you are walking along the beach and catch sight of a starfish on the sand or one moving slowly in a rocky pool, your interest is aroused, partly because of the distinctive form, partly because the sight is an unfamiliar one. How much greater would your surprise be if, instead of finding one of these creatures along the coast, you came across a lot of them on a rocky hillside in central New York state? Yet it was there that the specimens shown in the accompanying illustrations were found.

Rocks of the Devonian period in the central part of New York state are among the most productive in fossils and are called the Hamilton shales after the town of Hamilton, where Colgate University stands today. These rocks were laid down some 300 million years ago in the shallow seas which, in middle Devonian times, covered wide areas of the world, including a considerable part of New York state. Life in these seas was abundant, and the rocks of today are often wonderfully rich in fossils. The remains of shellfish, bryozoans, and other forms are often found here in profusion. Starfish, however, are not common in any formation and are rare in the Hamilton shales. We were exceptionally fortunate, while hunting in a road-cut near Cooperstown, to find the fragments of something unknown to us. Pieced together, they proved to be our first fossil starfish.

Since this discovery, we have combed the road-cut and adjoining banks and have collected a total of 70 specimens, if small fragments be included. Most of the specimens occur singly, but in a few instances we have found the fragmentary arms of several starfish in the same piece of shale and have noted portions of two starfish together a number of times. Our specimens have kindly been identified by John W. Wells, Professor of Geology at Cornell University. They include twenty-eight specimens of *Devonaster eucharis* (Hall), eleven of *Protaster logani* (Hall), one new species of *Encrinaster,* and seven examples of a type that Professor Wells considers a new genus and species.

Various other fossils — brachiopods, pelecypods, gastropods, and trilobites, as well as fragments of plant life—were found in the same locality. Collecting any of these specimens of life that existed long ago is an interesting experience; but the finding of a starfish—well, that is something a little special, certainly when it is "genus novum, species nova."



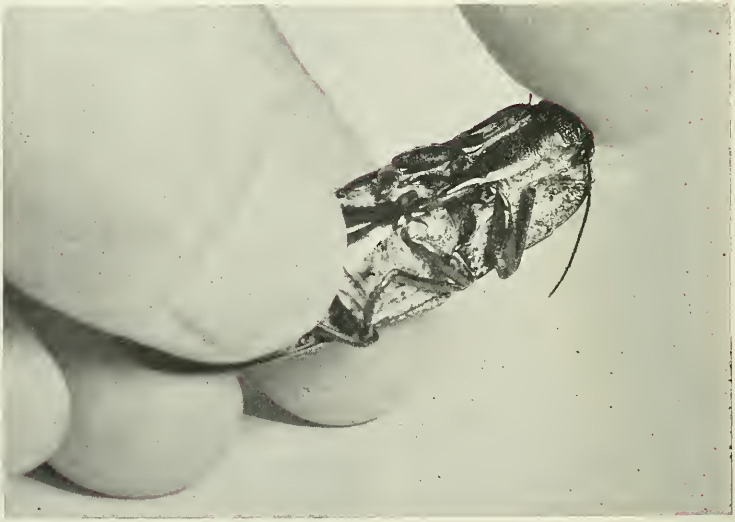


1 ▲ ON ITS BACK at the start, the beetle flattens, leveling the two sharply jointed portions of its body

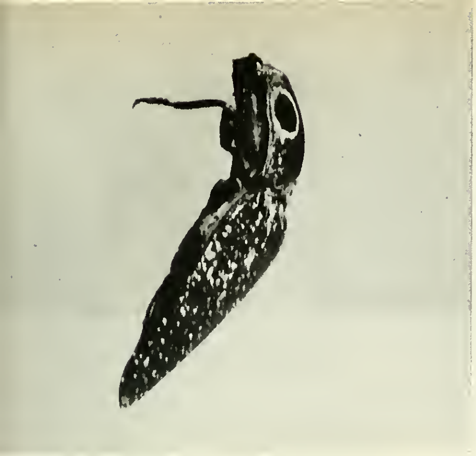
A Beetle th

With a
built-in inverter,
the click beetle
is never
on its back for long

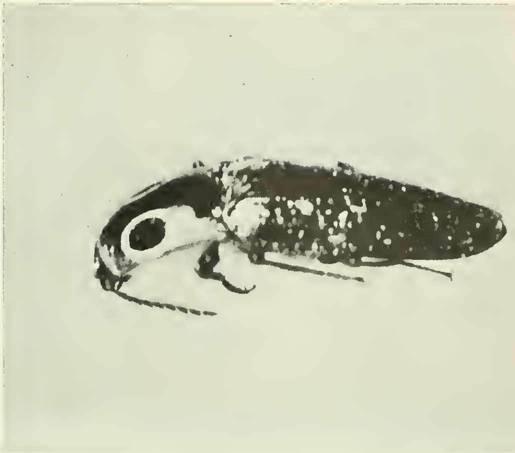
▲ THIS CLICK BEETLE is called an Eyed Elater. The name comes from the two dark spots on the prothorax, which possibly serve to frighten enemies.



➤ A MECHANISM that facilitates inversion is on the underside of the body. As the beetle snaps its forepart upward, a spine "clicks" into a groove, checking this motion. Momentum then flips the beetle over.



▲ Click-up! The beetle snaps its forepart upward and begins to swing through an arc that will ultimately land it on its feet.



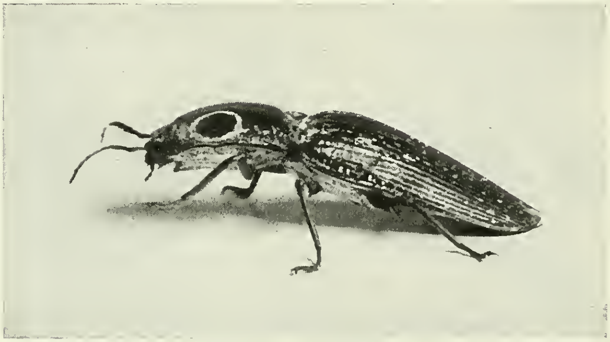
3 ▲ Still in the air, the beetle prepares to land. Action photographs were made with an electronic flash at 1/5,000th of a second.

omersaults

By

Ross E. Hutchins

All photographs by the author



4 ▲ Inversion complete, the beetle hesitates a moment, then rises on its legs and scuttles for safety.

Most insects are able to right themselves if placed on their backs, though many have difficulty doing so on a smooth surface. The click beetle has evolved an effective method of getting back on its feet from an up-side-down position on any sort of surface.

Probably all of the elaterid beetles use the same method, but the photographs reproduced here show the Eyed Elater, *Alaus oculatus* (L.), whose larvae, like many of the beetles of this family, live in rotten wood. Various other elaterids are widely distributed over the globe. The larvae of one species are known as wireworms and are extremely destructive to cereals, grasses, and root-crops.

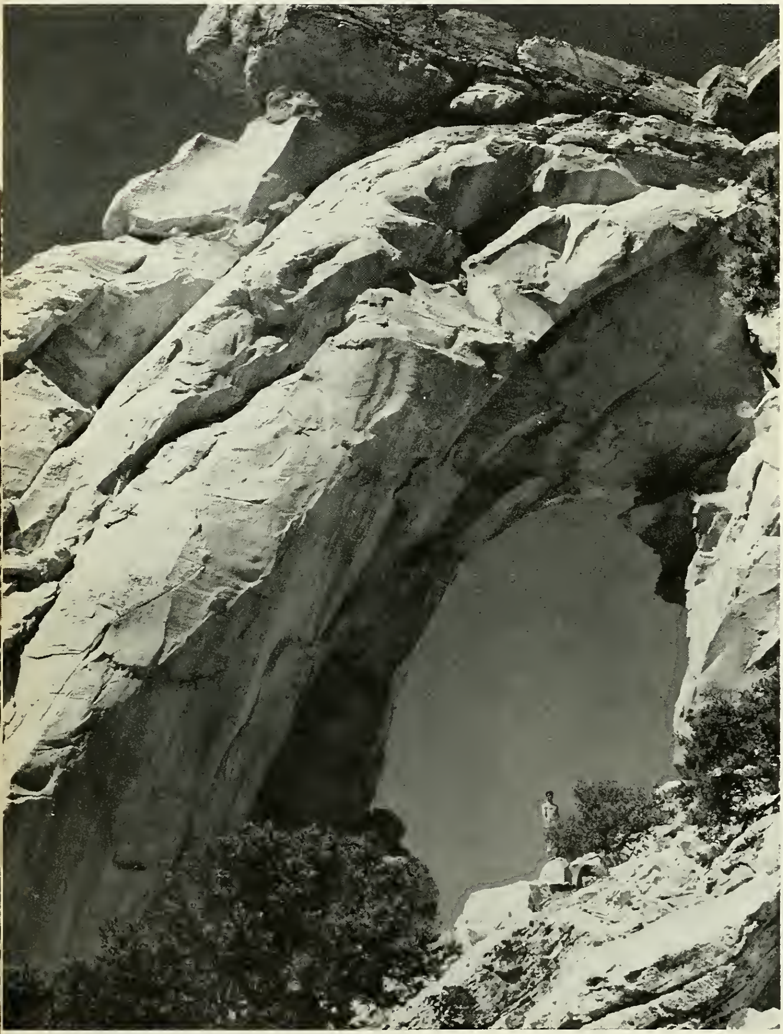
When these beetles are picked up by an unsuspecting person, they snap the forepart of the body with an audible click. The effect is somewhat like that received from a "palm buzzer" such as tricksters use for scaring their friends. The person usually drops the beetle as a result, and so may a bird that has taken the insect in its bill. Of course, this makes the trick of considerable value to the beetle. This ability to snap the body is also what enables the Eyed Elater to turn itself over and make a fast getaway.

In order to snap its body, the beetle straightens out until a spine on its prosternum (forepart, underside) is all but withdrawn from a matching groove on the mesosternum (afterpart, underside). Then, with a spring-like motion, built-up tension is released; the forepart flips upward, slamming the spine hard into the groove (click!), and the beetle flips into the air, usually landing on its feet.

If the attempt is unsuccessful, the beetle will repeat the performance immediately.

continued from page 146

the very heart of the mesa. The closer we got to it, the more imposing it appeared. Fragments of pottery on the steep slopes below showed that there had once been a prehistoric community in the cave. However, when we made our way up the slope, we found only one or two small fragments of masonry clinging to the walls around the edges and some building stone scattered over the steep sandy floor. On a ledge far in the rear of the cave was a row of deep grooves where ancient men had patiently ground their stone ax heads. The cave had once been occupied, but what had become of the houses? Apparently the ancient people had overcome the lack of level building space by constructing retaining walls of stone and filling in behind them to form terraces. Possibly a catastrophe had occurred while the people were still living there, but it is more probable that sometime later the retaining walls, weakened through the centuries, collapsed. Quantities of building stone strewn on the floor of the cave and the slopes below gave support to this theory, but without excavation by expert archaeologists the true explanation could not be known.



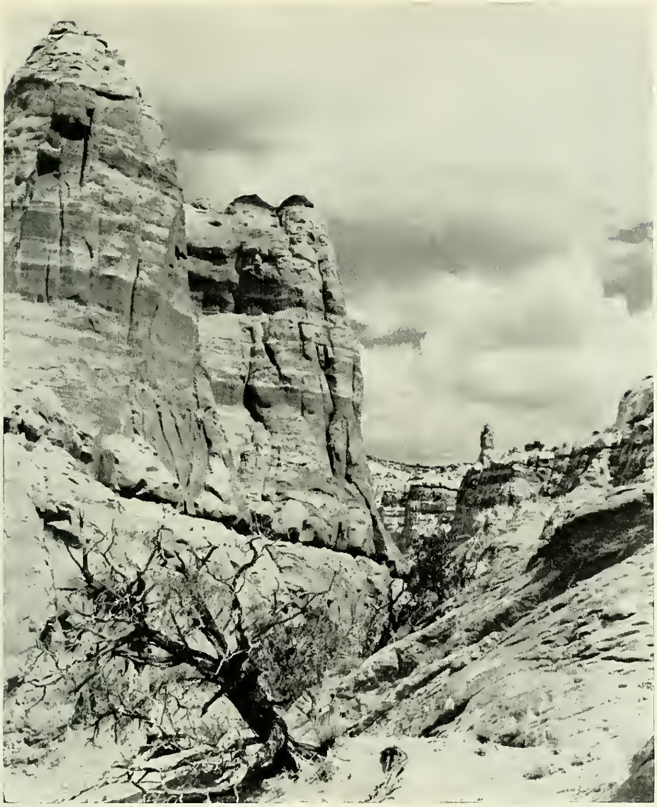
Art by wind and water

The number of natural arches we found was astonishing. There were two distinct types: flying buttresses like Little Window Rock, which is visible even from the road between Tuba City and Kayenta, and roughly parabolic archways that formed the portals to caves.

One of the flying buttress type, high up near the top of the cliffs, appeared rather small when seen from the canyon floor. But when we climbed up to its base, we were amazed by its grandeur. Near it was another almost identical one in the process of formation. It had not yet broken through to form a true arch, but in the near future — possibly within 1000 years — there will be twin arches within 100 yards of one another.

Of the type of arch that stands at the entrance to a cave, we found three. One was at the scene of the vanished village; one in the tributary of the main canyon, and the third towering over the main canyon. We came upon it suddenly one morning as we were driving along the floor of the canyon. We were almost below it before we became aware of it. The sight brought us to a sudden stop. The morning sun shone across it at just the right angle to highlight the graceful curves sweeping up into the sky, while the grotto under the archway lay in shadow. In short order, we were out with cameras recording for what may be the first time a formation

◄ FROM THE CANYON FLOOR it looked like a small hole through the rock. But viewed at close range, with a figure below it for scale, the true size of this arch was evident. The boy is more than 100 feet closer than the arch, yet he is still dwarfed by the towering structure.



▲ PICTURESQUE CLIFFS and narrow canyons typify White Mesa. The soft sandstone rapidly erodes into many strange forms. Narrow canyons thread their way through much of the mesa.

which several geologists now tell us is probably the most nearly perfect and symmetrical one of its kind ever reported (see cover picture).

With a tall spire fused into the western buttress, the arch looked just like a portion of some huge, ruined cathedral. There was no dispute when the name "Cathedral Arch" was suggested; it was the only name that seemed appropriate. Since we find in the literature no record of this magnificent arch, and since even the trader at Kaibito did not know of its existence, we hope that this name may be found acceptable.

We had enjoyed three weeks of exploring when we topped the pass in Mormon Ridge and looked back at White Mesa, its rugged cliffs gleaming in the afternoon sun. We had negotiated 380 miles of rugged country in the jeep and well over 100 miles by foot—measured on the horizontal. What it would amount to if all the ups and downs over the sand hills and cliffs were included, we shall never know. In spite of the heat, aching muscles, and other irritations, it had been a marvelous trip.

The exhilaration of living in the wilderness, the constant suspense of wondering what lay over the next hill or around the next bend in the canyon, the thrill of finding things that we had reason to believe no white man had ever seen before, all added to an enjoyment that life in the city scarcely provides. White Mesa had treated us well.

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TWELVE YEARS IN A "GREEN HEAVEN"

continued from page 127

greatest of all of their annual rites with the Kai-ya-ree dance.

The Kai-ya-ree is undertaken only when the peach-palm fruit (*Guilielma speciosa*) is ripe. This fruit makes a delicious and nutritious yellow-orange, slightly fermented beverage. The dance is one that continues without interruption for a day and a night. Only the men dance. While one man will not dance all that time, the ceremony is continuous and is actually a collection of 80 different dances in one—apparently representing the entire mythological history of the tribe, commencing with its beginnings, when the gods changed a tiny fish, which they call *o-mee-na,* into the first Yukuna men. The dancers wear shirts and skirts made from the pounded bark of *Olmedia* trees. They also wear masks, representing animals and men, made of the pitch from the rare and beautiful pink-flowered *Symphonia* tree. All of the songs and masks, according to Indian belief, were revealed to chiefs by the gods in yajé dreams. At the end of the dance, in the early morning hours, the mysterious balsa-wood mask, known as the *mulero,* is worn. It symbolizes a kind of semi-god of the ancient Yukunas and is the center of one of the most pleasingly graceful dances imaginable.

Like primitive peoples all over the world, the Indians have superstitions which arouse genuine fear. On one of my collecting trips, I had to pass through the awesome Jirijirimo rapids on the Apáporis River—a natural wonderland. Here, miles from the nearest Indian hut, in the midst of an immense jungle, the river suddenly narrows from about a mile's width down to 60 or 100 feet. It then rushes headlong over a waterfall and cascades down nearly a hundred feet, thereafter to flow through a canyon for some ten miles. In some places it narrows to a mere 20 feet, and at one place in the canyon the water disappears entirely as it runs through a natural tunnel.

At the falls, many enormous boulders are strewn helter skelter, and a giant face has been carved by nature on one of the cliffs. As we drew near this area, my young Indian guide, Kapi, grew visibly nervous. When I urged him to paddle on, he shook his head and indicated that he wanted to go ashore. My civilized helper and I paddled on through the tunnel ourselves, and Kapi met us farther downstream—after a 15-mile walk! His explanation was that, according to tribal lore, the boulders were actually the souls of dead Indian leaders and that the giant face belonged to a huge stone god who guarded their spirits. It was taboo for any Indian to look upon that face. This belief was so compelling among the Taiwanos that they had worn trails through the forests over which they dragged their canoes for 15 miles rather than pass the great stone face by the river.

"Green Hell" doesn't exist

Though wilderness areas are always fascinating, it is unfortunate that an aura of awe has grown up around the tropical jungle and an almost laughable aura of heroism around those who "brave the green Hell." Life there is certainly much freer from physical danger than on our modern highways. Many of the misconceptions are created by writers of books of "exploration." The young scientist should know that far too many of these are written solely to sell. The man who, after a few short weeks in the jungle, produces a thriller in which death is avoided almost daily, natives are treacherous, man-eating animals lurk in every bush, and supplies are always lost at the critical moment, is either exaggerating greatly or else unfit to be loose outside a large city.

I shall never forget the remark of a friend of mine, a botanist and explorer, who said: "If an expedition is always meeting unusual obstacles or hair-raising adventures, it is a sure sign that it was poorly organized and carried out." Although I cannot pose as an advisor, I cannot refrain from saying to anyone starting a career as a plant-scientist: Do not be over-awed by the unknown. Go into your new territory as though you were about to go into the Maine woods on a two-week deer-hunting trip.

Does plant exploration in the jungle over a long period make a man dissatisfied with civilization? My answer is that a botanist would be remiss in his professional obligations if he let such a thing happen. New knowledge cannot be made available unless it is worked up for publication in our botanical institutions and libraries. Field work is but a preliminary part.

Nevertheless, I do miss the Amazon. I know that there are untold botanical discoveries yet to be made there, even in that little piece of the Amazon Valley that lies within Colombia's borders, and, some day, I hope to paddle down the rivers and tread the jungle trails again.

My sentiments are like those expressed by Charles Waterton, that great British traveler of a century and a half ago, speaking of Guiana:

"Gentle reader, after staying a few weeks in England, I strayed across the Alps and the Apennines and returned home but could not tarry. Guiana still whispered in my ear and seemed to invite me once more to wander through her distant forests."

The Colombian Amazon frequently whispers to me.

In response to a request from the editors of NATURAL HISTORY, Dr. Schultes prepared a list of useful books for persons who wish a more extensive introduction to Amazonian exploration and tropical botany. Following are selections from that list.

Spruce, R. (edited by A. R. Wallace): *Notes of A Botanist on the Amazon and Andes* (1908) 2 vol.

Herndon, W. L.: *Exploration of the Valley of the Amazon* (1854), recently reissued.

Bates, H. W.: *The Naturalist on the River Amazon* (1864).

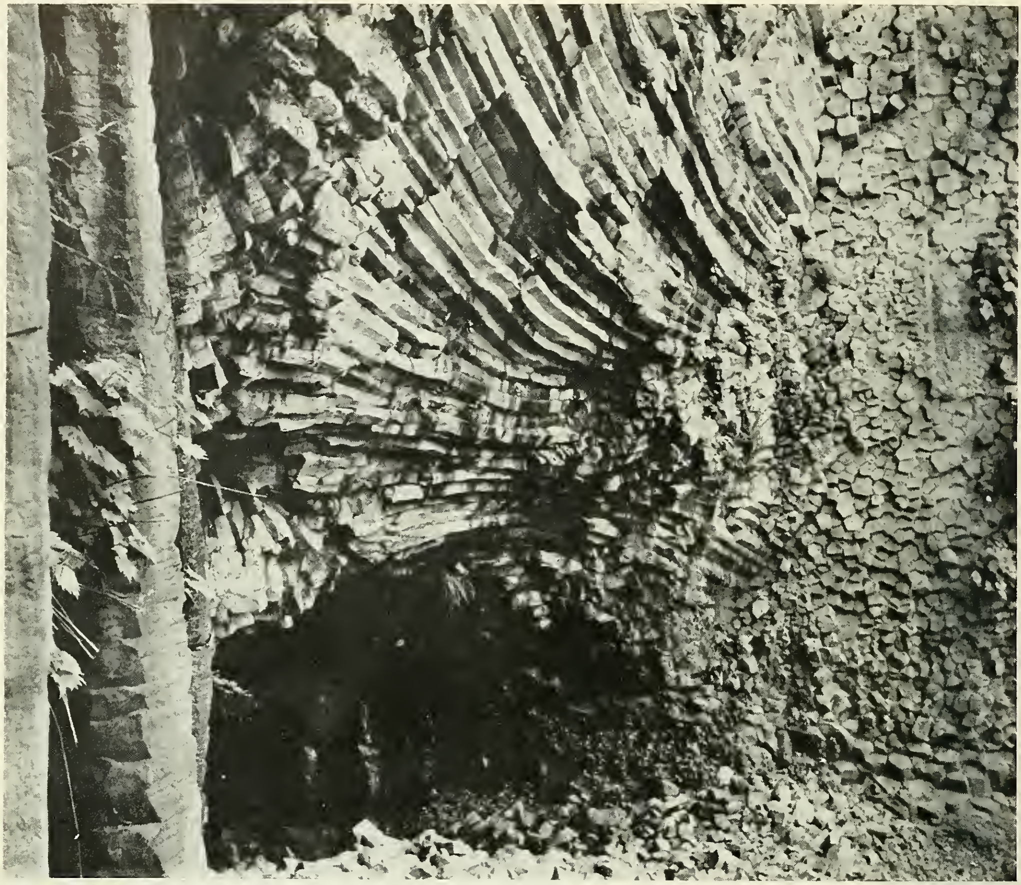
Schomburgk, R. (translated by W. E. Roth): *Travels in British Guiana* (1923).

Goodspeed, T. H.: *Plant Hunters in the Andes* (1941).

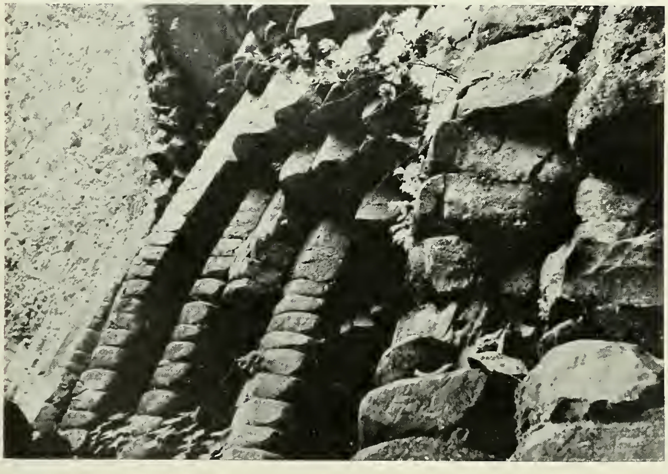
vonHagen, V. W.: *South America Called Them* (1948).

Richards, P. W.: *The Tropical Rain Forest* (1952).

Verdoon, F. (editor): *Plants and Plant Science in Latin America* (1945).



Japanese wonderland. This basalt cave (see letter) has been designated a Natural Monument by the government of Japan. Readers will be interested in comparing these pictures with those of the Devils Postpile, a U. S. National Monument located in California's San Joaquin River valley (Natural History, Jan., 1955).



LETTERS

Basalt across the Sea

Sirs:

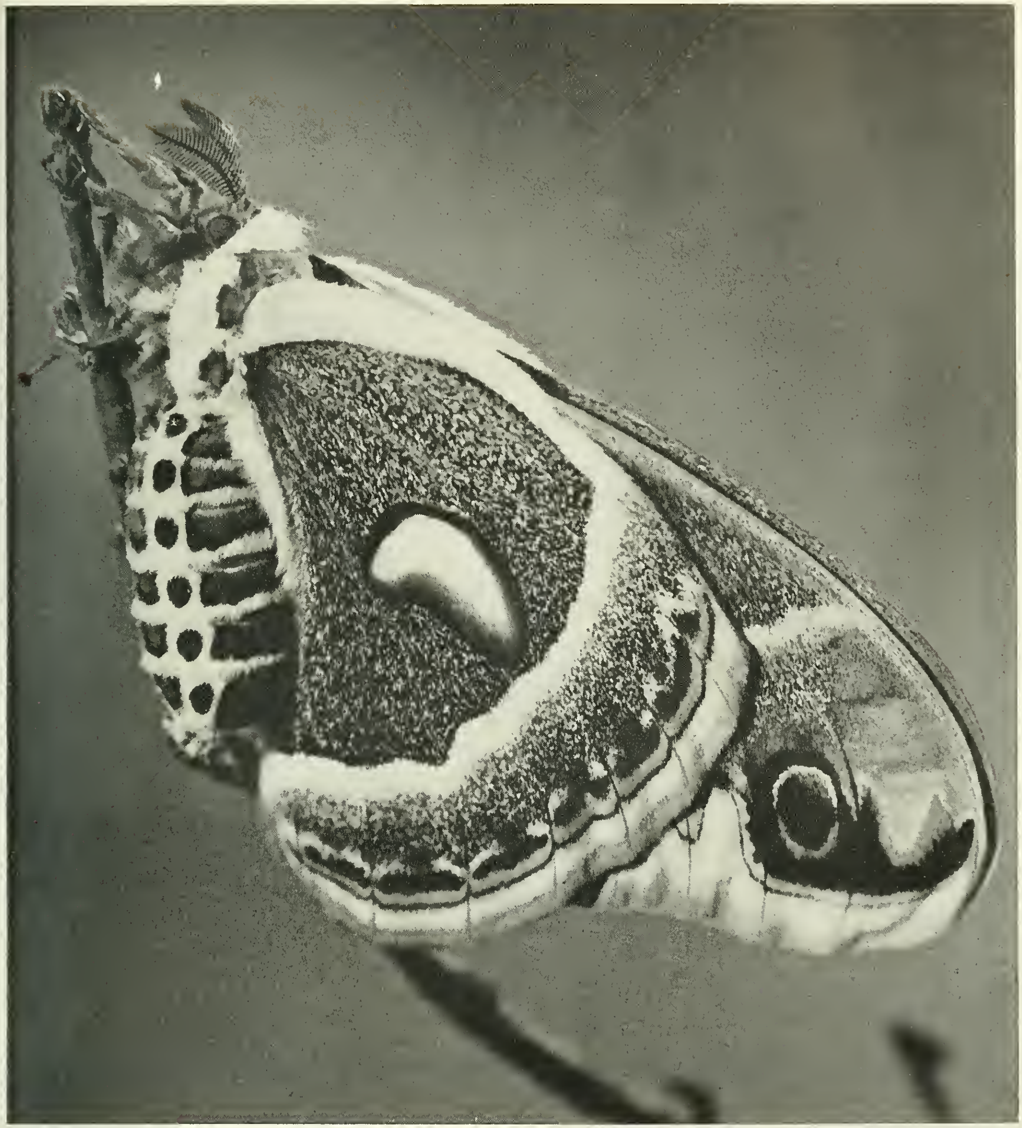
The article in your January issue describing Devils Postpile National Monument in western United States prompts me to write you about a similar formation in my country, which the Japanese government has designated a Natural Monument.

It is a basalt cave and cliff located at Tazuno-mura, Kinosaki-gun, Hyogo-ken, Japan (near Osaka on the island of Honshu). The cave is quite large and has subterranean water bubbling up from its floor. The columnar, black, basalt rocks lining it and covering the face of the cliff are usually five sided (each side measuring about two feet). Some of them have a series of transverse crevices, making them resemble tall stacks of cakes . . .

The Japanese people have a sentimental attachment for these rocks, since they are symbolic of our ancestral architecture, in which basalt stone was often used for construction.

Kaoru Murai

Osaka, Japan



▲ A female cecropia moth (about twice life-size). This moth is well known to boy-naturalists who prowl the woods in winter, for it is then that the Cecropia is easiest to obtain. Often the possessor knows only that he found a silky brown cocoon attached to a twig and that it will "turn into something" if he keeps it. Usual aftermath is for the cocoon to be placed in a cigar box and forgotten until, sometime later, this incredible creature emerges.

Attack with incentive

Sirs:

I found your article entitled "Kruger's Animal Fair" most fascinating and read every word of it. The lions are far more accommodating in Kruger Park than those in the Congo and British East Africa. The author also gives the impression they are less troublesome to the rhinoceros and the hippopotamus. I don't know about rhinos or about conditions in South Africa, but in the Belgian Congo lions frequently attack hippos. In April 1953 Walt Disney's photographers, the Milottes, photographed five or six lions floating down a river on a hippo that was believed to have been killed by the lions. Sometime later, at the head of Lake Edward, Park Director Haezaert showed Dr. and Mrs. James Chapin and me the remains of a hippo several hundred feet from the water. Mr. Haezaert had seen it attacked by six lions only a day or two before. It seemed noteworthy that one lion remained

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to act as a sentry. So lions do sometimes attack these animals if there is sufficient incentive.

C. R. VOSE

St. John,
Virgin Islands

SIRS:

The article on Eskimo clothing by Stefansson was a corker!

THEODORE M. SWITZ

Chicago, Ill.

SIRS:

. . . I feel called upon to disagree with Mr. Edward A. Herron, author of your article on the Holly of Death Valley. While we would all agree with his main thesis, lamenting the thoughtless devastation of natural areas by stupid people, he seems to have mistaken the buds of the plant, which are red and round like tiny berries, for seeds, as other people have done. If he had watched these "seeds" for a few days, he would have seen them "burst" into the minute yellow flowers he speaks of. The seeds, on the contrary, are at no time red. They start out pale green and when mature are pale tan or cream colored . . .

THEODORE M. HAYES
Principal, Twentynine Palms High School

Twentynine Palms, Calif.

From an Artist:

I'll be a subscriber to NATURAL HISTORY as long as I live. I particularly enjoy the bird pictures.

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From a Lawyer:

I am very fond of NATURAL HISTORY, and it is one of the few periodicals I keep indefinitely.

Films previously reviewed

Documentary and Grade A	**What the Experts Said**
Hunters of the Deep Undersea Life filmed in color	An excellent opportunity to become acquainted with the ocean's depths
The Purple Plain A vivid portrayal of man's struggle against the elements	A highly recommended film, shot in the Burmese jungle
20,000 Leagues Under the Sea Based on Jules Verne's book by the same name	Little natural history, but wonderful entertainment
The Vanishing Prairie A Disney film dealing with the vanishing wildlife of the American prairie	Exciting, instructive, and highly entertaining
Down the Alphabet	
Quest for the Lost City Adventures of the Lambs during their quest to discover a lost Maya city	Incredibly contrived piece of nonsense
Underwater "Underwater" is an adventure story built around a search for sunken treasure	Viewer sees little undersea life
Vera Cruz Filmed in Mexico. Story built around Maximilian's brief reign	Scenery good. Otherwise just a flamboyant "Western"

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Concerto in C for Two Trumpets and Orchestra
Netherlands Philharmonic Orch., H. Sevenstern and F. Hausdoerfer, Trumpeters, Otto Ackermann, Cond.

WAGNER
Die Meistersinger, Prelude, Act 1
Zurich Tonhalle Orch., Otto Ackermann, Conducting

BACH
Toccata and Fugue in D Minor
Alexander Schreiner at the Organ of the Tabernacle Salt Lake City

DUKAS
Sorcerer's Apprentice
Utrecht Symphony, Paul Hupperts, Conducting

MOUSSORGSKY
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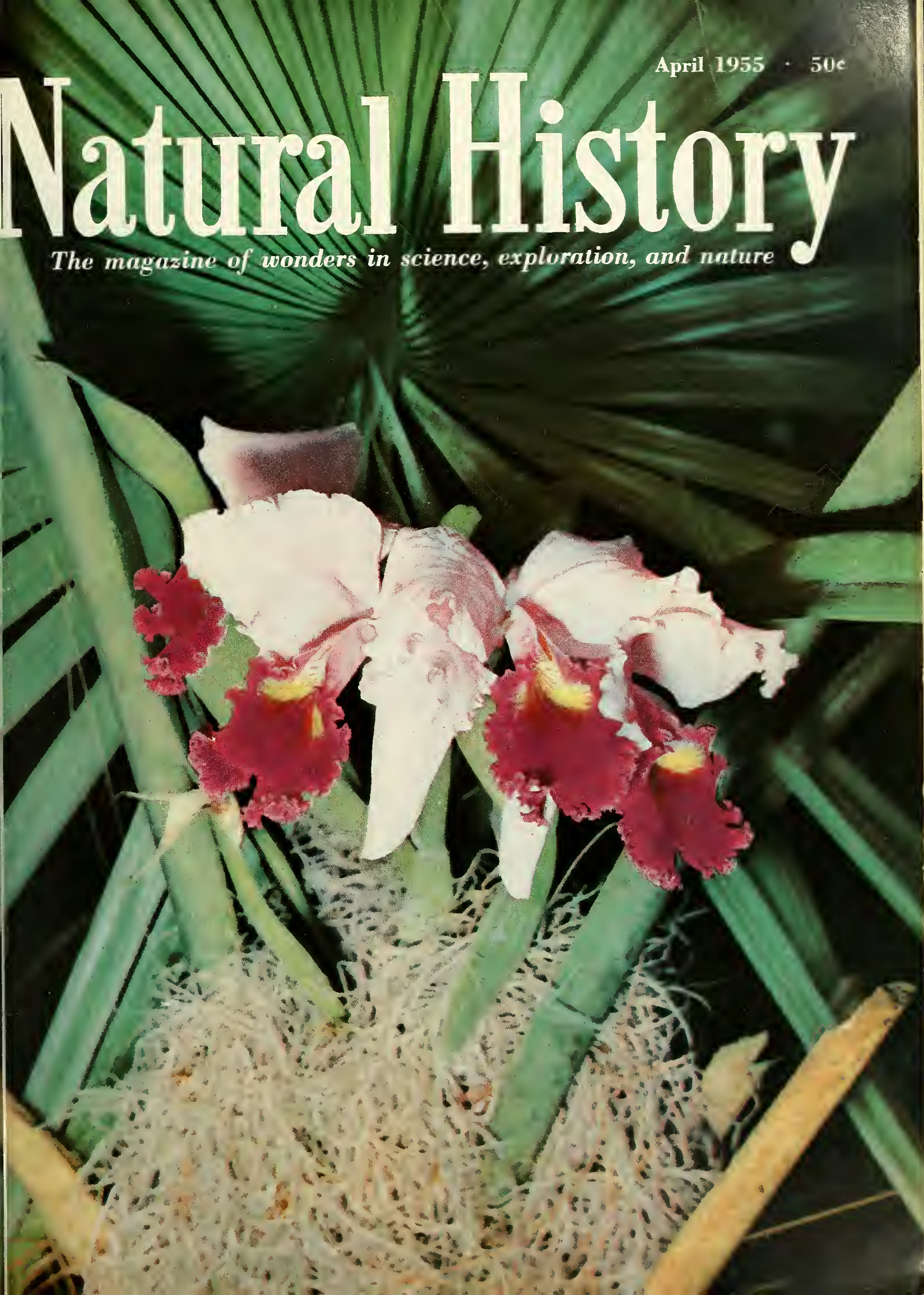

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The Batekes live in the Belgian Congo and French Equatorial Africa. Their best-known works are medicine statues carved from wood. These are frequently characterized by erect figures, large heads, short, bent legs, beards resembling those worn by the tribal elders, and a stylized hairdo shaped like a crown or crested helmet. This fine example, at right, is fairly representative and is reproduced with great success in Alvastone. Standing 14¾ inches high, it is guaranteed to monopolize conversation in any company. One of the most arresting African figures available in reproduction.

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LETTERS

Ben Franklin Knew It

Sirs:

I read with great interest your article, "Clothes Make the Eskimo," in Natural History.

You probably will think this letter is a joke, coming from someone who lives on the so-called balmy shores of Mobile Bay. Nevertheless ... it really can get bitterly cold in the winter here, especially in a duck blind. I am interested in securing a caribou Eskimo parka to wear over my skin in the approved entrapped-air method of keeping warm. Can you suggest how I may go about securing this garment?

Incidentally, architects should do more functional planning to make buildings comfortable without the necessity for relying completely on mechanical air conditioning. They would do well to read your article, which I thought excellent.

Harry Inge Johnstone
Mobile, Ala.

Vilhjalmur Stefansson, the author of the article, answers as follows:

I am not in the habit of thinking that Mobile Bay is frigid, though I do know that the lowest temperatures of Florida are colder than the lowest records of the capital of Iceland.

It is no longer easy to secure decent Eskimo garments, for the white man has so perverted the Eskimos that scarcely a trace of that special merit remains which made their garments excellent and in some ways unique.

Actually, it would probably not be worth any special bother to utilize gravitational air control either in clothing or in housing except where the temperature is likely to go below 0°F. and more or less stay there for a month or two. However, if you are building in a side hill anyway, you might as well enter at the lower side of your building. Then on a cold day you can afford to keep your door open, if the upper part of the house is reasonably tight ....

A writer rarely has opportunity so quickly to amend what he has written. It may be recalled that I implied in my article that LcR. P. E. Petitot may have been the first to inform civilized people of the air-capture principle used by Eskimos to heat their homes. I have now discov-

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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April, 1955 Volume LXIV, No. 4

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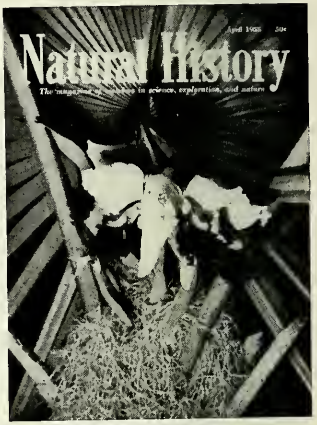
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Natural History
The magazine of adventures in science, exploration, and nature

THE COVER THIS MONTH

The orchid on the cover of this month's Natural History Magazine is a Cattleya hybrid, typical of the spectacular forms popular in corsages. The orchids are one of the largest groups of flowering plants, embracing many thousands of species. Most are tropical, but some occur as far north as Greenland.

The one shown here has been attached artificially to a cabbage palm. The grower selects a suitable spot on the trunk where the plant will receive filtered sunlight, nails a pad of osmunda fiber to the tree, and fastens the base or roots of the orchid firmly to it. If he has done his work well, the plant will become accustomed to its adopted position within six months.

Amateur orchid growers, who strive to duplicate climatic conditions agreeable to imported species and are interested in the amazingly intricate methods of pollinations, have an absorbing and unending field of inquiry.

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The land of the free and the home of the egret ...and it's yours

The newest, and only sub-tropical National Park in the United States, the Everglades is, in a sense, the most American of all, for it is primarily a *refuge*. Here, the once-hunted egret and other spectacular bird species live unmolested; even the alligator is an honored guest. Nowhere else in America will you see such large congregations of birds and such unusual plant life as in this Florida wonderland that belongs to you. It has been said that each of the 28 National Parks has a special lesson for those who look for it. The Everglades makes you know what it is to be free.

A Salute to the National Audubon Society

Sinclair salutes the membership of the National Audubon Society for 50 years of outstanding accomplishment in the conservation of America's wildlife, plants, soil and water.

The Society, which has headquarters at 1130 Fifth Avenue, New York City, was a major force in the establishment of Everglades National Park and conducts Wildlife Tours there today.

Perhaps the brightest feather in its cap was the saving of the egret. Years ago, when fashion decreed that every lady wear a feather on her hat, thousands of egrets were slaughtered for their plumage. The Society roused public opinion against the fashion. The plumed hat became a badge of shame and its sale eventually prohibited by law.

As a result of the Audubon Society's efforts, the egret was saved from extinction to become a symbol of the Society's many achievements in conservation.

MOTORISTS—if you would like to visit the National Parks by car, the Sinclair Tour Bureau will help you plan your trip. Write: Sinclair Oil Corporation, Sinclair Oil Building, 600 Fifth Avenue, New York 20, N.Y.

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JIVARO: AMONG THE HEAD-SHRINKERS OF THE AMAZON

- - - - - - - - - - by Bertrand Flornoy

Library Publishers, $3.95
224 pp., 43 photographs, 2 maps

THE present contribution is the latest in a seemingly-endless series of popular handbooks on how to shrink heads in the Ecuadorian jungles. The subject has been good copy for professional explorers of the Upper Amazon since 1899, and at this point the gruesome process must be at least as familiar to American housewives as Fanny Farmer's recipe for white sauce.

For that matter, so is the general pattern of the book. There is the usual mule train across the Andes, and the inevitable lost supplies (this time clearly expendable; a total of 4,500 pounds of them were toted along). The adventurers are beset by standard obstacles: impenetrable jungle, torrential rain, teeming insects, venomous snakes, and menacing Indians. The author even has the nerve to repeat that most shop-worn cliché of the mud-and-mosquito school of exploration about the Amazonian savages who prefer classical music to boogie-woogie. Perhaps I move in lowbrow circles, but the forest Indians I know prefer Mambo to Mozart any day in the week.

What concerns me most about the recent flood of descriptive accounts by professional explorers who have but the merest nodding acquaintance with science is simply this: where they differ from accepted authorities, how do we evaluate their narratives? For example, Flornoy's is the only source I know stating that Jivaro women are dirty, downtrodden, and that they do the weaving. Accounts by reliable scientists describe Jivaro women as cleanly and dignified, and point out specifically that, unlike their neighbors, Jivaro men do the weaving. Such discrepancies could be multiplied indefinitely, and certainly no other jungle explorer I have read claims to have hunted seal on the Upper Amazon. Even the recipe for head-shrinking is off-beat. Maybe on this occasion some nonconformist Jivaro omitted a traditional herb or two. More likely the head-hunters are just plain tired of concocting their astringent brews with explorers breathing down their necks.

Harry Tschopik, Jr.

QATABAN AND SHEBA

- - - - - - - - by Wendell Phillips

Harcourt, Brace and Co., $5.00
362 pp., 87 photos.

ARABIA'S role in the history of the ancient Near East has never been clearly ascertained, primarily because both political and geographical conditions have acted as effective barriers to archaeological research. Wendell Phillips in a characteristically bold and enterprising manner has overcome these barriers sufficiently to lead four expeditions into particularly difficult regions of southern Arabia.

These archaeological campaigns permitted such outstanding scholars as W. F. Albright, Alexander Honeyman, and Albert Jamme to excavate at the ruins of the capitals of ancient kingdoms whose histories are but vaguely related in Near Eastern sources. The excavations uncovered architectural features, art objects, and important inscriptions, which reveal how significant a role these kingdoms played in ancient times. These excavations are of great importance in increasing our knowledge of the foundations of civilization.

The book is well illustrated, and Phillips writes in an entertaining manner about the apparently endless difficulties of maintaining field parties in such regions. Most of the archaeological material has not been published before. The reader, therefore, has an opportunity to view, through the pictures especially, a series of objects that are unique to Old World archaeology.

For those who want the vicarious excitement of discovery, plus the ruggedness of expedition life in a remote part of the world, *Qataban and Sheba* should fill the bill.

Walter A. Fairservis, Jr.

SOUTH COL — A PERSONAL STORY OF THE ASCENT OF EVEREST

- - - - - - - - - - by Wilfred Noyce

William Sloane Assoc. $5.00, 300 pp.,
71 photos, 4 color plates, 5 maps,
16 drawings

THIS recent addition to the rapidly growing list of books on mountain climbing has much to be said for it, but it is also vulnerable to criticism, and this reviewer is somewhat puzzled as to how to evaluate the over-all impression. It should be mentioned at the outset that some very good books on this topic have appeared during the past few years, and high standards for narration, description, and illustration have been set. The competition to get out a new book on mountain-climbing might be compared to the race to be first on the summit itself.

South Col gives in intimate personal account of one man working on a team that has subordinated the individual to the greater achievement of the unit as a whole. The author seemingly has the qualifications to bring him to the crest of Everest had he been designated on a final assault team. He climbed to the highest base camp and probably would have been on the next two-man team to push for the top had Hillary and Tensing not been successful.

The narrative is frank and sometimes very revealing. Some of the incidents described show how human weaknesses and failings turn up despite long planning and the penalties exacted for carelessness. The reader gets a very good insight into the day-by-day activities of a stupendous undertaking. But this lengthy recording makes the story drag in places to a point of monotony.

The half-tone illustrations are very good. They are well selected, and the reader is impressed by the terrifying difficulties of the terrain to be crossed. The few color plates are poor in quality, and one may wonder why some of these particular shots were selected. The sketch maps are very helpful. The slap-dash drawings are highly impressionistic and disappointing for the most part.

Harold E. Anthony

THE EVOLUTION OF AN INSECT SOCIETY

- - - - - by Derek Wragge Morley

Charles Scribner's Sons, $3.95
215 pp., 3 tables, 31 plates

FROM time immemorial man has been curious about the ways of ants, as historical writings show. The most famous of all remarks concerning ants is that in which Solomon admonished a lazy man to "Go to the ant, thou sluggard." Had Solomon been wiser, he would not have made the remark, because there are lazy ants as well as active ones, and even some active ants may not be producing anything for the good of the colony.

In this book Dr. Morley does not mention the fallacious statements made by many writers concerning the intelligence and ingenuity of ants, but he clearly debunks all such claims. This he does by describing the activity in and around a community of mounds built by *Formica rufa* (which, in England, is called the "Wood Ant"), during 15 years of observation. In America, there is no widely accepted common name for this ant, which occurs throughout the north temperate zone, but it is known regionally as the "Mound Ant" or "Mound Building Ant."

In order to show the evolution of social life among ants, Dr. Morley outlines the community life of the most primitive of living ants, in which there is no community co-operation except when there are eggs or young in the primitive nest. The development of the social habit within the nest is traced to the point where all individuals in a community of as many as a million ants co-operate.

Dr. Morley studied a community of five living nests, plus some "dead" ones, all of which originated from a single mound. This structure extends six feet above the ground and three feet below. Paths lead to the outlying nests, with which there is constant communication. In nest one, which is over 40 years old, there are 500,000 workers and 64 queens. Nest two has 300,000 workers and 35 queens, and so on down as the age of the nest decreases.

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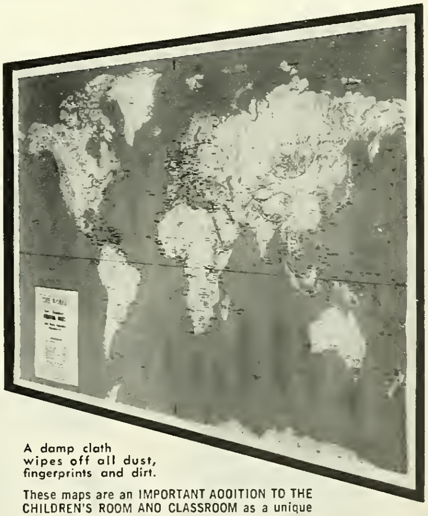

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reading, but it is not tedious. This is undoubtedly the finest popular book yet published on ants, and the scientific standing of the author is such that there can be no question about the authenticity of his observations.

C. H. Curran

How to know the minerals and rocks

- - - - - - - - - by Richard M. Pearl

192 pp., 29 figs., 8 plates with
46 color photos of minerals.
McGraw-Hill Book Co., New York, $3.50

The author is Professor of Geology at Colorado College and is well known for his earlier books on minerals and gems. With this latest publication he has produced a useful little manual for the amateur mineral collector. It is particularly suitable for the beginner, as it assumes no previous knowledge of the subject and has good introductory chapters on mineral collecting as a hobby, how rocks and minerals are formed, how to build up a mineral collection, and the identification of minerals by their physical properties.

The major part of the book is devoted to brief descriptions of 105 minerals and 22 rocks, selected as being those an amateur is likely to meet. The descriptions of the minerals are arranged according to an identification key based on luster (metallic or non-metallic), color, hardness, and cleavage. While this is fairly satisfactory, it leads to more than half the minerals being keyed as "Non-metallic luster: leaves white mark or scratch on streak plate." Although Moh's scale of hardness is explained in an introductory chapter, the Moh's hardness of the individual minerals is seldom stated.

The drawings of the minerals and rocks are generally good, but the color photographs are sometimes misleading as a result of unsatisfactory reproduction of the colors—hematite appears green, instead of red-brown; malachite bright blue, instead of green; limonite pink and blue, instead of brown. The descriptions of the minerals and rocks are brief but on the whole adequate, although some oversimplification and possible misstatements have crept in, and one might criticize the author's choice of the localities mentioned. On the whole, however, this book is well suited for its prospective reader, the amateur mineral collector, and can be recommended.

Brian Mason

All about language

- - - - - - - - - - - - by Mario Pei

Decorations by Donat Ivanovsky
J. B. Lippincott Company, $2.75
186 pp., 4 maps

Dr. Pei is an eminent professor of languages at Columbia University. If this sounds formidable, it is not, in that Dr. Pei has the great and rare gift of making extremely complicated material sound not only intelligible, but interesting as well.

Linguistics is without question the most exact and scientific of the social sciences. In its technical form it is not only Greek, but merely gibberish to the uninitiated layman. The average introductory textbook to linguistics is as lucid as Beowulf in the original with explanatory notes in early Persian. *All About Language* is both readable and informative.

My chief criticism of it is not a valid criticism at all. According to the jacket the book is addressed to an audience of age 12 and up. Linguistically speaking I admit that I am age 12, or under, but still I find it informative and entertaining; actually, it is the first book on the subject I have ever felt I understood. If the sentence structure is occasionally too simple, the ideas are not, nor is the humor that pervades this most readable book. In capsule form it tells the reader a great deal about language: why it originated, how it works, its function, diversity, and history. Unobtrusively, it becomes apparent that Dr. Pei knows a great deal about anthropology and about people. In a very real sense the study of language is the study of the growth and spread of human culture generally, and any adult or intelligent child will profit by reading this book. More than that, he will be amused.

The section treating place names and personal names is very entertaining, and throughout one has the feeling that he is being introduced to a new and fascinating puzzle. After having been scared green of linguistics at a more impressionable age, I now feel able to tackle the subject anew.

Harry Tschopik, Jr.

Our American weather

- - - - - by George H. T. Kimble

McGraw-Hill, $4.75, 322 pp., 25 figs.

Our American Weather, by Dr. George H. T. Kimble is an authoritative, highly informative textbook on general American meteorology. The author has used a unique format and a pleasant writing style to offset the more traditional devices that mark most books of this type. Repeatedly, his emphasis falls on the practical aspects of weather: where and when to vacation, how to use the facts of weather to help business, which of the widely accepted notions have basis in fact.

Some readers will accept reluctantly the Kimble-induced demise of the groundhog-shadow theory of continuing winter weather—reluctant not because of any absence of reason or proof on the part of the author, but because of the unwillingness of most of us to accept such a revolution in our weather lore. There is compensation, however, in his support of many other of our ideas, rhymes, and riddles.

There are twelve chapters — one for each month of the year. The dominant weather feature of the month is the topic of each chapter: January, temperature extremes; February, snow; March, wind; etc. Some are absorbingly interesting, others recount fact after fact in a rather routine, sometimes monotonous manner. All are predicated on careful research, and are written in clear, uncomplicated language. Dr. Kimble's treatment of rain and snow formation, causes of lightning and thunder, and other phenomena for which explanations are

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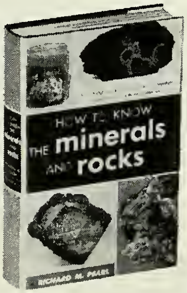

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Conside

▲ PLANTATION-STYLE collecting of coconuts is done with extremely long-handled "banana knives," the shafts of which are made up of sections of bamboo fitted together.

COURT etiquette in the once glorious Celestial Empire of China required that the "Son of Heaven" be given any dishes his royal appetite desired. Therefore, from time immemorial, only foods available in all seasons were placed before the young princes of Old China. But once, we are told, the young Emperor tasted a three-layer coconut cake at the Imperial German Legation and was captivated by its attractive appearance and luscious flavor. The next evening, the quiet dignity of the oriental night was rudely broken by his demand for "more coconut cake." The entire palace was aroused. Excited Manchu exclamations ascended toward heaven when repeated efforts proved unable to prepare this delicacy in the palace kitchen. There was general consternation. Finally, word was rushed to the legation, and the household of the diplomat was called forth from its Teutonic slumbers. Finally, to the relief of the palace steward, coconut and good German baking satisfied the royal wish.

Centuries before, this same fruit had won the favor of Sir Francis Drake, who, while at the Cape Verde Islands in 1577, wrote that

Henricks Hodge

▲ A GLANCE into the interior of a coconut palm will reveal the clusters of fibrous-husked nuts. Sometimes as many as a hundred will be borne by one tree.

he COCONUT

From the thatched roofs of the tropics to the icing on Junior's birthday cake, the rich gifts of this productive palm have brightened the lives of princes and paupers in many lands

By HARRY PEALE HALDT

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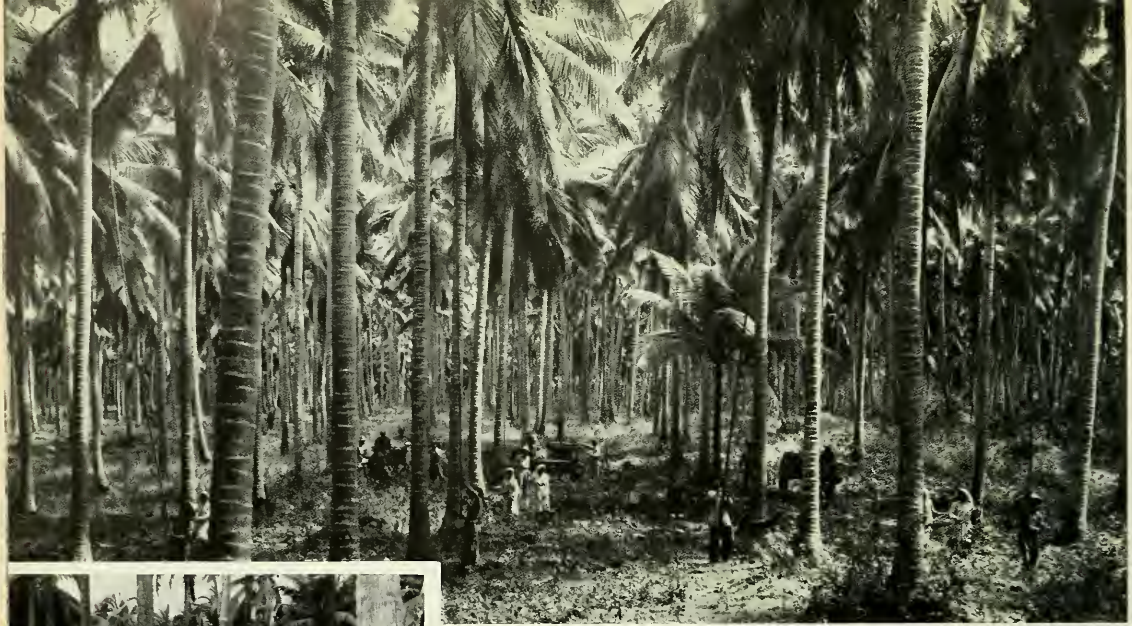
Edwin Weigel



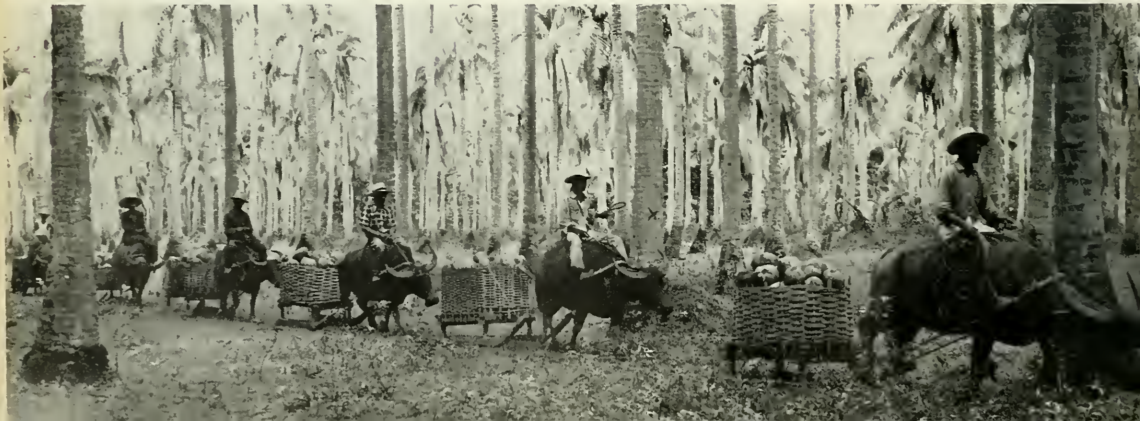
▲ Harvesters at work in a typical Philippine coconut grove. Men with long-shafted knives cut the ripe nuts from the trees; others with sharp-pointed sticks gather them into piles, while still others load them into carts.

within the shell of the then scarcely known coconut was *"a kinde of substance very white, no lesse goode and sweete than almonds."* And down to our present day, the coconut has constantly gained in popularity, and it retains its title as the staff of life throughout the South Seas and most tropic isles.

Changes in the market value of this extraordinary product disturb the sleep of commodity traders in New York, London, and Marseilles, as well as the life patterns of primitive Melanesians in New Guinea and the Solomons. The coconut supports the mystery-shrouded Chinese trader of song and story from Tahiti to the Strait of Malacca and is the subject of daily conversation from the sophisticated Manila Hotel to the spicy wharves of Colombo in Ceylon.

Throughout this vast area, and including our own American tropics, it is estimated that some five to six million acres—an area about twice the size of Connecticut—are required to satisfy the world's demand for coconut. Some fifteen to eighteen billion nuts are harvested each year—approximately

▼ Odd-looking sleds, drawn by carabao (water buffalo), are sometimes used to transport coconuts out of the groves.



seven for every man, woman, and child throughout the world.

That's a lot of coconut pies, cakes, macaroons, bonbons, and candy bars. In the United States alone, 105 million pounds or more of shredded coconut are used each year. In addition, 385,000 tons of coconut oil or the equivalent in copra for pressing into oil are imported into the United States for margarine, cosmetics, soap, and pharmaceuticals. And then there are the "coco" doormats, cordage, and sturdy, all-weather fiber rugs.

All these, and thousands of thatched roofs and homemade utensils used by natives throughout the tropic islands, are the product of a tree that has been an object of wonder and admiration through the centuries. One of the oldest references is that of Cosmas, the Egyptian traveler, who in A.D. 545 wrote, "*Another tree is that which bears the Argell, that is, the great Nut of India.*" Marco Polo, in describing Sumatra in about 1290, tells us that the coconut grew there and contained "*an edible substance that is sweet and pleasant to the taste and white as milk. The cavity of this pulp is filled with a liquid clear as water, cool and better flavored, and more delicious than wine or any other kind of drink whatever.*" Friar Jordanus in 1328 gave a more general description, calling the coconut "Nargil." This word is interesting because it shows where the Arabs and Iranians got the name of their waterpipe, or nargilla, in which the bowl for holding the water was often made from a coconut shell.

By the close of the fifteenth century, we begin to hear coconuts mentioned as *coguos* in da Gama's voyage. In 1553 comes *coco*, but in 1755, Dr. Samuel Johnson's Dictionary unfortunately changed the spelling to "coco*a*nut" through an error in combining the cocoa bean (from which chocolate is obtained) with the coconut palm.

Matlike support

The food-factory that is the coconut palm draws nutrient minerals from the soil through 4000 to 8000 roots issuing from its base and radiating through the surface soil. Many roots go no deeper than 18 inches, few more than 4 feet. But they radiate outward 15 to 25 feet, or even 30 feet in light sandy soils. They are usually uniform in diameter, about the thickness of a pencil. The growing end is protected by a tough cap, behind which is a two-inch area of delicate skin where absorption of water takes place. The remainder of each root is covered with a tough sheath, practically impervious to water. This has evolved to meet such varying conditions as are found on the edge of the salt ocean, along the wet sides of rice paddies, or in inland places where there are long dry spells. In overmoist situations, the skin protects the inner fibers from becoming watersoaked; and when the tree is confronted with long dry seasons, the hard outer skin simply covers up the soft absorbing section until better growing conditions return. Then the cap pushes forward, permitting formation of new tissues to take up the moisture.

The coconut palm is a thirsty organism. It has been shown by planters in Ceylon that a tree weighing 2000 pounds will consist of about 1200 pounds water. It has been estimated that 400 to 500 pounds of water are needed to produce one pound of dry matter.

Amid the leaves at the plumelike top are the nuts. Each is a single seed, and they are among the largest seeds in the world. They develop, after pollination, from branching flower clusters formed at the bases of the leaves. There is nothing to prevent pollen from male flowers pollinating female flowers on the same tree, because flowers and fruits in all stages of development can be found on a single tree at any time. The nuts grow rather slowly. What we call the meat of the coconut is really food for the developing embryo and is technically called the endosperm. In the young fruit, this is a liquid, but it gradually becomes firm, and by nine months the meat is at its greatest thickness.

The coconut palm cannot be grown commercially beyond about 20 degrees north and south of the equator, though trees do bear nuts a few degrees farther from the equator in subtropical Florida and Madagascar. The nearer to the equator, in general, the better the yield. The best production is often on rich flatlands along the lower reaches of rivers. But this remarkable tree has also adjusted itself to produce on the sandy beaches of Indian Ocean islands and in the

◄ **Skilled workers** remove the outer husks by means of sharp plow points on portable stands. Pale nuts at the right are freshly husked and will turn brown after a few hours' exposure to the air.

almost pure coral strands of the South Seas, where it is at times the only economically important plant.

When we think of the coconut, pictures of far-off South Sea isles come to mind—bright coral beaches with the palms nodding gracefully above a lazy tropical ocean; and that is quite proper, since much botanical evidence points to Malaysia as the ancestral home of the coconut, even though its definite origin is still in some doubt.

The fibrous husk of the nut fits it to travel long distances by sea. Not only is it light and buoyant, but the outer shell of the husk is coated with a veneer of wax that waterproofs it. A coconut with its husk in good condition was found on the beach of Ronsay Island in the Orkneys, north of Scotland.

Almost wherever native peoples have found the coconut palm, they have recognized its broad usefulness. The leaves are made into baskets, matting, and roof thatch. Rafters and building material come from the trunk; cordage from the husk; cups, spoons, and ladles from the hard shell; salads from the bud; toddy from sap drawn from the young flower spathes, and, of course, meat and milk from the nut. Indeed, more than 1000 uses make the coconut palm *(Cocos nucifera)* one of the most important trees in the world.

Many stands of coconut trees have established themselves naturally, but most of the commercially productive groves have been set by hand and cultivated. The jungle is cleared by burning the brush and cutting or bulldozing the heavier growth. On most plantations, coconuts are propagated simply by placing the whole nuts on their sides close together in nursery beds and lightly covering them with soil. Germination occurs in three months, and at ten months young seedlings may be transplanted to the field. Within seven to ten years, the young trees begin bearing, and they reach full productivity in about fifteen years. A tree may continue to bear profitably for from 50 to 70 or occasionally 100 years. The yields vary markedly, and much depends upon proper spacing. On the better managed plantations 25 to 30 feet is the rule.

On most young plantations, beans, upland rice, maize, or other local crops are planted among the trees as a source of ready cash. Later, cattle may graze between the trunks.

Although the meat of the coconut reaches maximum thickness in about nine months, the quality and quantity of oil-bearing cells increase on up through the 12th or 13th month.

A lofty crop

Harvesting usually takes place at two- or three-month intervals throughout the year. In the Philippines, experienced harvesters, working from the ground, cut the ripe nuts from the trees by means of a heavy knife blade fastened to the top of a long bamboo pole. The pole is made of sections fitted into each other and held firmly in place by wooden pins. In other areas, the nuts are gathered simply by allowing them to ripen and fall.

In some countries it is the custom for men to climb the trees at harvest time. The climbers sometimes ascend without benefit of climbing accessories, but the harvester may join his feet with a rope or leather loop just long enough to permit a good grip on the trunk. He then clutches the tree with his hands and inches his way up to the bunches of fruit. When the crown is reached, another loop is sometimes placed around the tree and the man's waist so he can use both hands in selecting and cutting the nuts.

In Africa, pegs are often driven into the trees, and in some groves notches are cut into the trunks to help the men climb. These latter methods are now frowned upon because they injure the trees.

Nuts intended for copra (coconut meat from which the oil is to be extracted) generally are allowed to "season" in piles for several weeks to increase the oil yield, especially when harvesting may have included nuts that were not fully mature. But nuts harvested to produce the shredded coconut of commerce should be fully mature.

To remove the husks, agile, trim-waisted young men, protected with tough leather cuffs on their forearms and leather aprons or chaps on their thighs, bash the nuts against heavy spikes set firmly in the ground or in special stands. Each of these young athletes tears the fibery husks away from about a thousand nuts a day.

At this stage there emerges the conventional coconut that we see in grocery markets. If you have ever chased one of these elusive objects around the kitchen with a hatchet, you probably felt yourself quite a craftsman if you succeeded in chipping away the shell in seven or eight minutes without sacrificing any fingers. Expert factory "openers," using tools resembling oyster knives, remove the shells of at least three or four nuts a minute. To preserve the white color of the meat, they do it without presteaming. Also, they almost always manage to complete the operation without breaking the kernels, so that the brown "skins" can easily be removed.

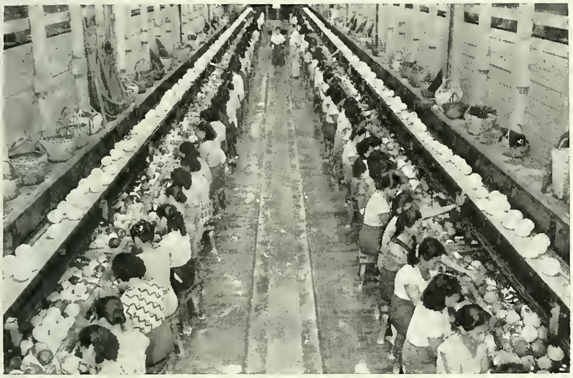
"Shavers," using sharp knives, then remove the skins at the rate of two or three a minute, which afterward are sold to coconut oil crushers who recover the 60 per cent fat that the skins contain.

Husking, opening, and shaving are all paid for on a piecework basis. In the Philippines, the shells are collected and burned as fuel in the drying factories and also are shoveled into the fireboxes of railway engines.

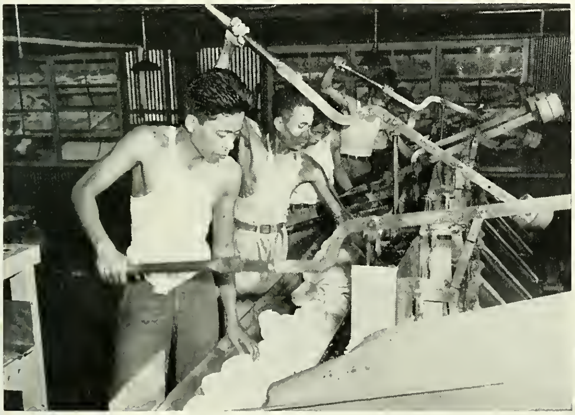
After the shells and skins have been removed, the white spheres of coconut meat are "capped" to release unwanted fluid, and carried by conveyor belt to washing tables, where they are sprayed in fresh water and inspected for discoloration. From here they move to the thread mills where a plunger holds each one against a revolving disk set with knives. The meat is forced between the blades and emerges

continued on page 218

▲ PINT-SIZED LOCOMOTIVE nudges a car filled with coconuts to an unloading center for counting. Discarded coconut shells are frequently used as fuel for fireboxes.

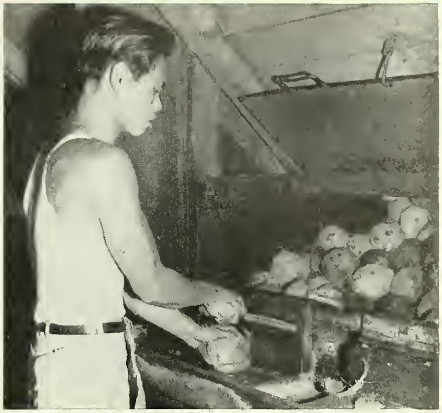


▲ A PRODUCTION LINE for skinning coconuts. The thin brown skins are pared off by deft-fingered girls at the rate of 250 per hour.



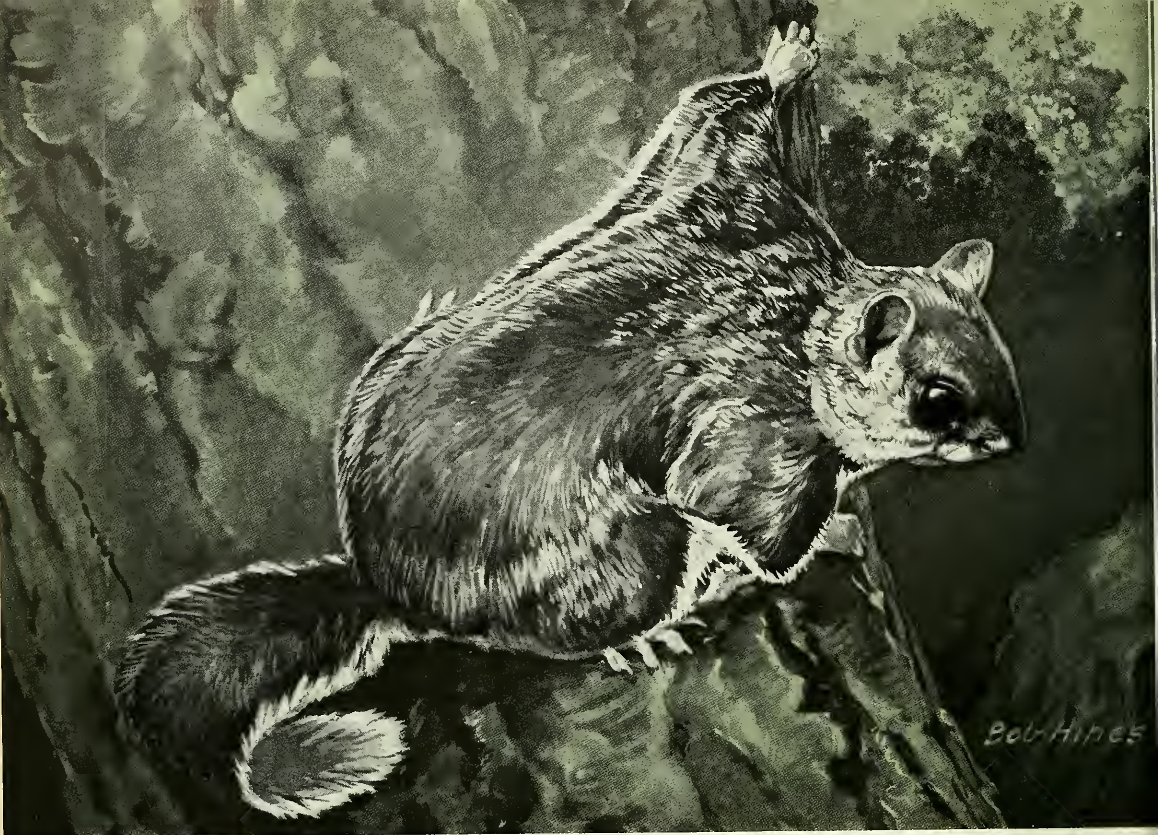
▲ SHREDDING is accomplished with manually operated vertical plungers, which force the coconuts against the blades of spinning knives.

➤ A MILL FOREMAN holds a sample of wet, freshly-shredded coconut that has just emerged from the thread mill. From here it will move on a conveyor belt to dryers; thence to sieves for sorting by length, and finally into heavy paper bags for shipment.



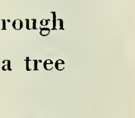
▲ STRIPPING OFF THE SHELL is accomplished in two stages. First the coconut is placed on an anvil and soundly thwacked with a tool like a tire-iron. When the shell is thoroughly cracked, it is pried off with a short-bladed knife. The pieces fall to a conveyor beneath for recovery.

▲ COCONUTS are "capped" to allow the milk (which has no commercial use) to drain out before they are washed and inspected for discolorations.



▲ THE FLYING SQUIRREL is native to eastern United States, southwestern Ontario, and parts of Mexico.

Assapanick–



mite of the night

With uncanny accuracy, the tiny flying squirrel glides through the darkness to a well-gauged landing at the base of a tree

By WILL BARKER
Illustrations by Bob Hines

ONE might almost think the little flying squirrel is a mathematician. Before taking a leap from the top of a tree, it peers about, changing position first to one side and then the other, as if it could gauge the distance to its chosen landing spot by geometrical triangulation. For those readers who may doubt the squirrel's competence in such calculations, it may suffice to say that the animal normally looks before it leaps.

Once distance is gauged, the squirrel launches itself into the air, with its legs at right angles to its tiny, white-bellied body, so that the loose membranes are stretched taut into a planing surface. After gliding down to its destination, it checks its momentum by an upward swoop and lands, with head toward the treetop, exactly on the spot of its choice. The flying squirrel's tail, which measures half its total length of nine inches, is the rudder that guides its flight.

That a flying squirrel gauges distance is lent credibility by what happens when it doesn't. If you startle one of these little creatures by rapping on the base of its home—perhaps a hollow tree in a forest or wooded park—it will pop out and take off without pausing. This uncalculated leap may land it on the ground or in the water. The latter is disastrous for a flying squirrel, since, because of its encumbering membranes, it is one of the few animals that cannot swim.

The flying squirrel is actually a glider, not a flyer, though the second word of its scientific name, *Glaucomys volans,* comes from the Latin verb, to fly. Freely translated, the full scientific name means "silvery-gray mouse that flies."

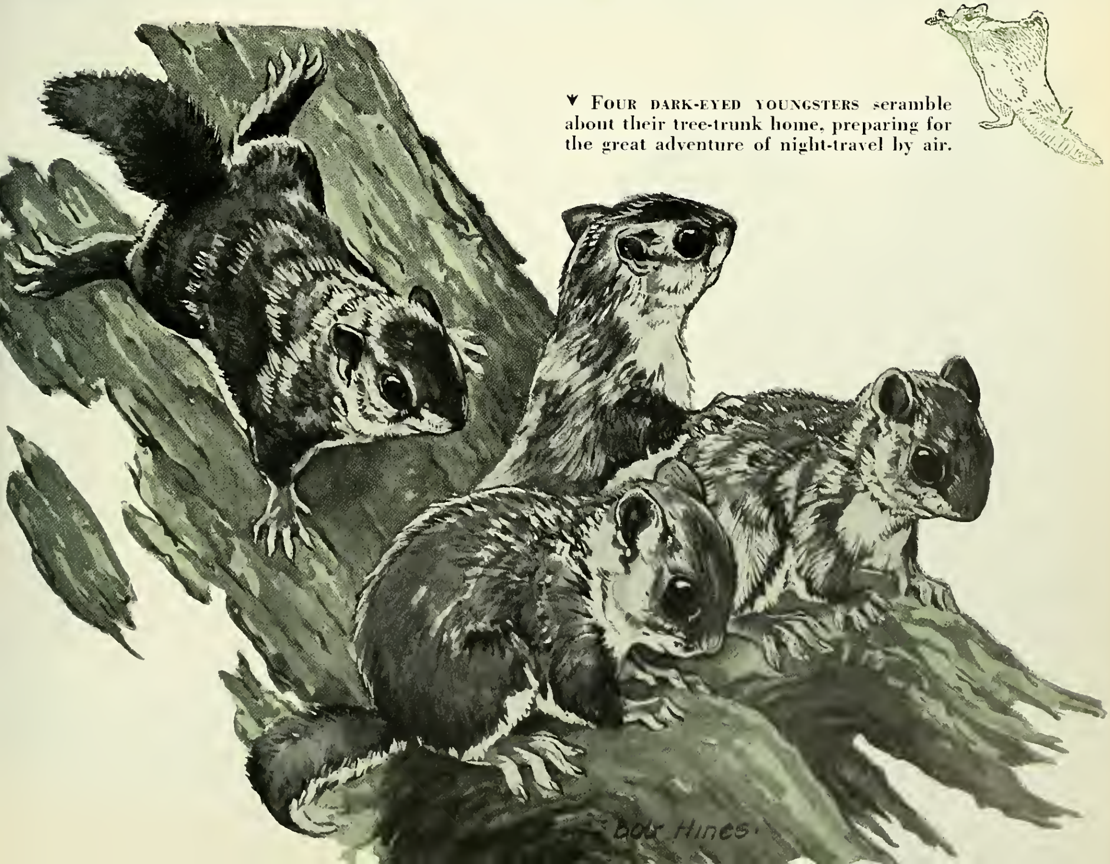
The mouse that flies is quite articulate. For ordinary occasions, it uses a *chuck, chuck, chuck,* very similar to that of other squirrels. When angry or alarmed, sharp squeals are in order. And at other times, the vocalizing is much like a bird song—a clear, musical chirping, sometimes harsh, repeated for several minutes at a time.

An extremely active animal, the flying squirrel burns up energy quickly and needs a lot of food. It consumes huge quantities of tree buds in the winter, since it does not hibernate, and eats corn, fruit, and nuts when these are in season. Nuts are necessary to keep the teeth sharp. Eggs and young of birds are also eaten at times.

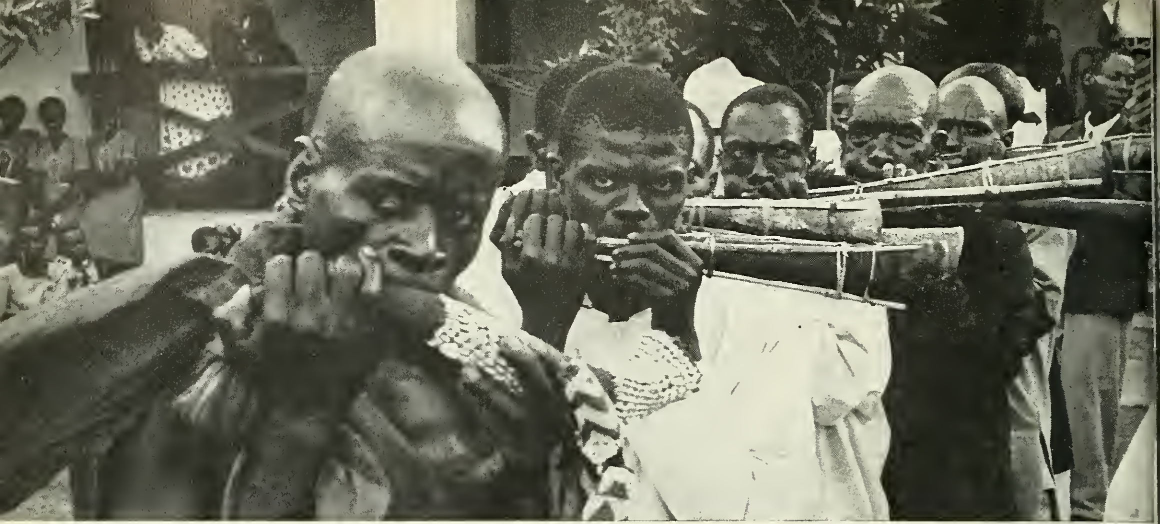
Starting late in February, one or more litters of .three to six flying squirrels are born each year. The young are about the size of a quarter – naked, red, and wrinkled as raisins. Their home is generally a deserted woodpecker's nest lined with shreds of bark, moss, feathers, fur and other soft materials. Sometimes an outside nest is built, much like the leafy nests of the gray squirrel, except that it has a warm inner lining that makes it snug enough for winter use. Whatever the kind of nest, the flying squirrel always locates itself near water, since it is a heavy drinker and consumes nightly the equivalent of about two gallons for a man.

Without doubt, the incredible little flying squirrel has fascinated men throughout the history of our country, for it was none other than Captain John Smith who mentioned it first, in his *The Generall Historie of Virginia,* published in 1624, saying:

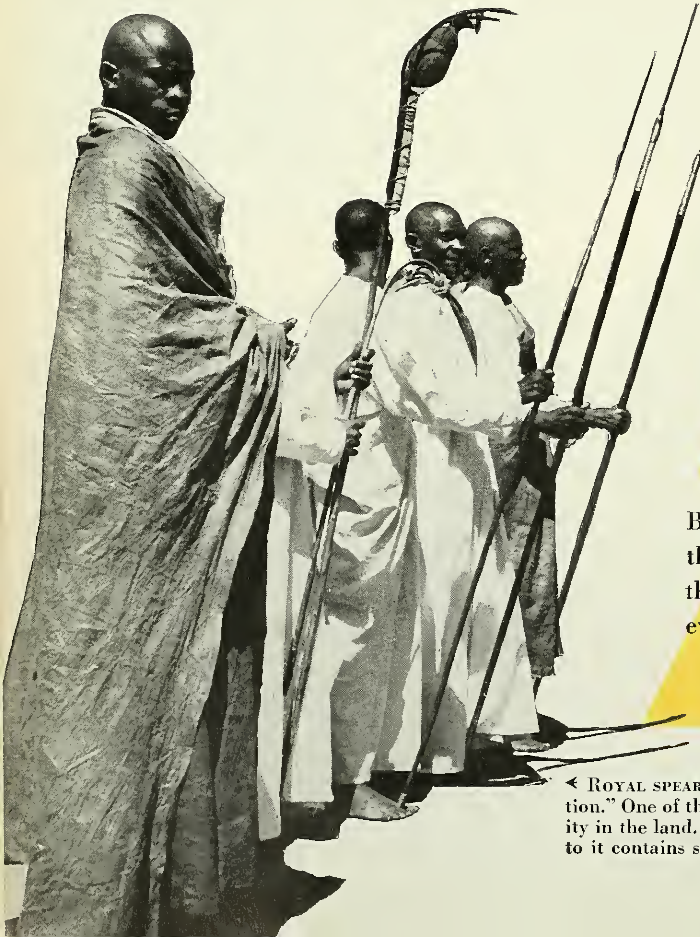
"A small beaste they have, they call Assapanick, but we call them flying squirrels, because spreading their legs, and so stretching the largenesse of their skins . . . they have beene seene to fly 30 or 40 yards."



▼ **FOUR DARK-EYED YOUNGSTERS** scramble about their tree-trunk home, preparing for the great adventure of night-travel by air.



▲ ROYAL TRUMPETERS announced that the festivities were to start. Most of the trumpets are of soft wood, the flaring portion being covered with rawhide. The beaded one, however, is sacred, for it is believed to have been used by the first king of the ancient dynasty, who was hunting when he received word of his accession to the throne.

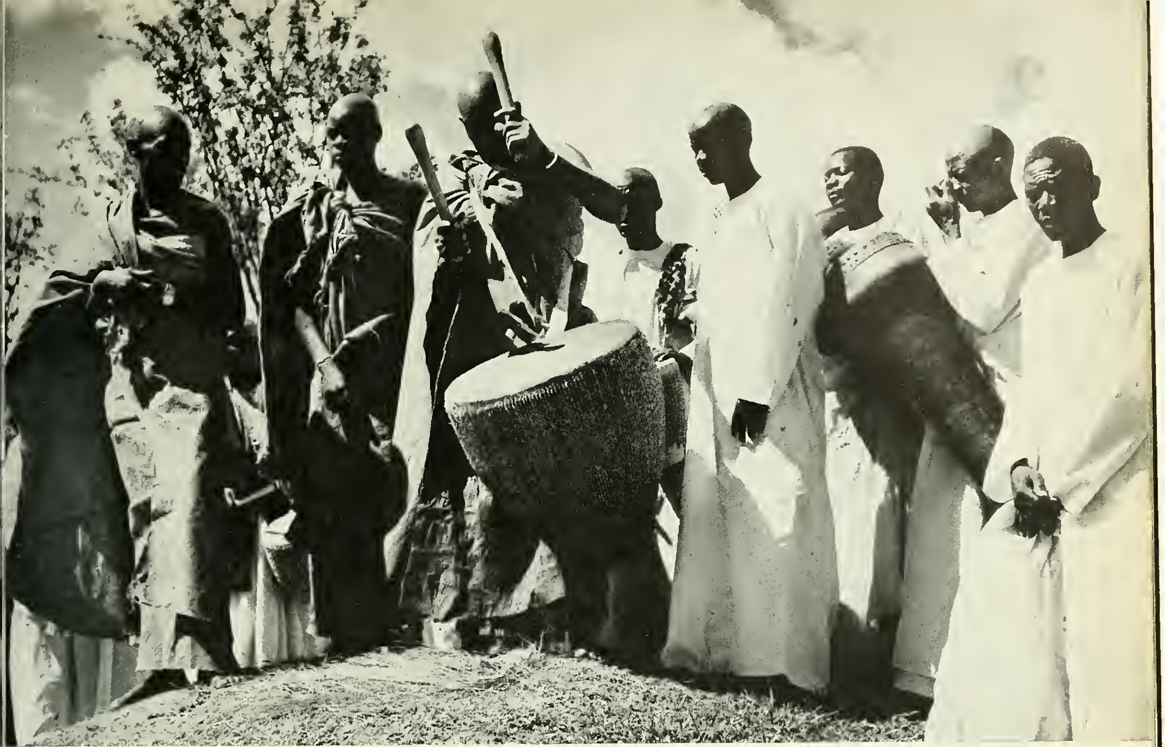


Ceremony in BUNYORO

Brilliant trappings and ancient rites mar
the Thirtieth Anniversary of the ruler o
the oldest kingdom in Central Africa — a
event perhaps never before photographe

By GEORGE RODGE
Magnum Phot

◄ ROYAL SPEAR CARRIERS led the procession before the "coronation." One of these men carries the Royal Rake, symbol of fertility in the land. It resembles a forked stick. The leather bag tied to it contains sample seeds of all the crops grown in Bunyoro.



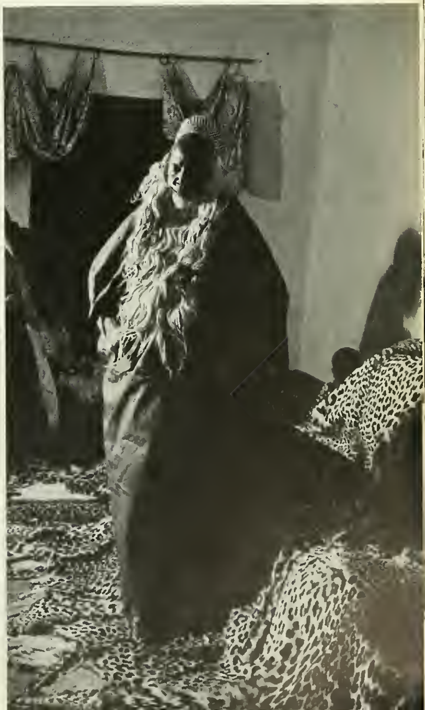
NLY THE ROYAL DRUMMER, aside from the King himself or in members of the Royal Household, may beat the Sacred l Drum. The ceremonies (called "Mpango" after the y concerned with preservation of ritual) begin around the Sacred Mound (Kaswa), originally the fireplace of the first king. Men of the Regalia wear ancient costumes of bark cloth dyed in ochre. In the old days, Royal Executioners would select a number of bystanders for ceremonial execution.

THE elaborate re-crowning ceremonies that recently signalized the Thirtieth Anniversary of the Omukama of Bunyoro followed faithfully the original of 30 years ago, but a modern touch was added to the ancient regalia in the form of the royal limousine.

Bunyoro, about twice as big as Delaware, is one of four kingdoms existing within the Uganda Protectorate, the others being Buganda, Toro, and Ankole. The King of Bunyoro has the most ancient lineage and can trace his ancestry through 30 generations. He is Tito Gafabusa Winyi IV, Commander of the Order of the British Empire, a man of about 63. His grandfather was king when John Speke and James Augustus Grant discovered the territory in 1862.

The ceremonies lasted seven days, during which the King was frequently re-crowned and various of the ceremonies were repeated. Approximately 10,000 of Bunyoro's 120,000 subjects were on hand to witness or take part in the ceremonies.

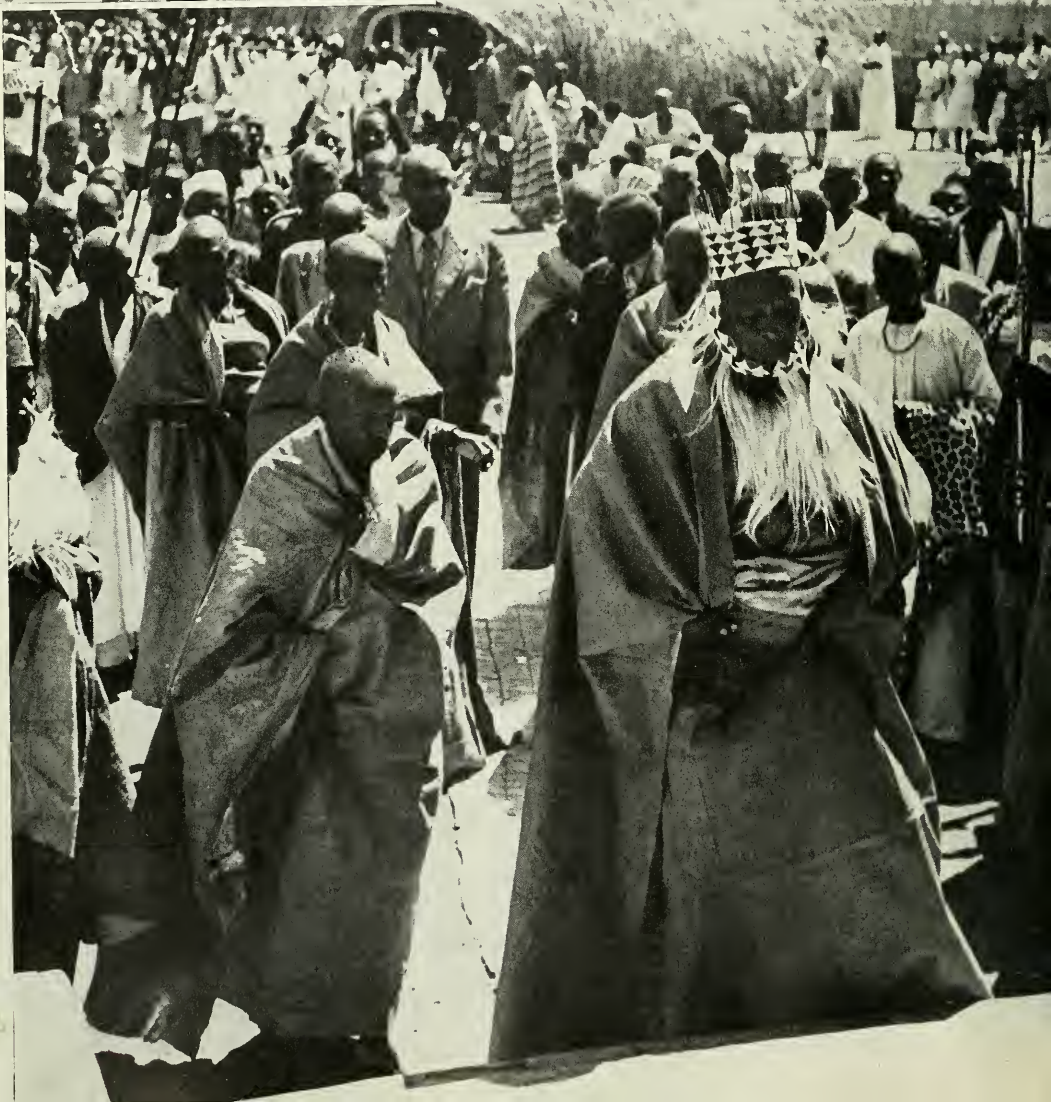
On the opening day, there was a gathering of neighboring kings, chieftains, and representatives of the Protectorate. Royal trumpeters made their way among the thatched huts in the palace compounds announcing the start. The King and his entourage then began the ceremonies with services at Anglican St. Peter's Cathedral in Hoima, for

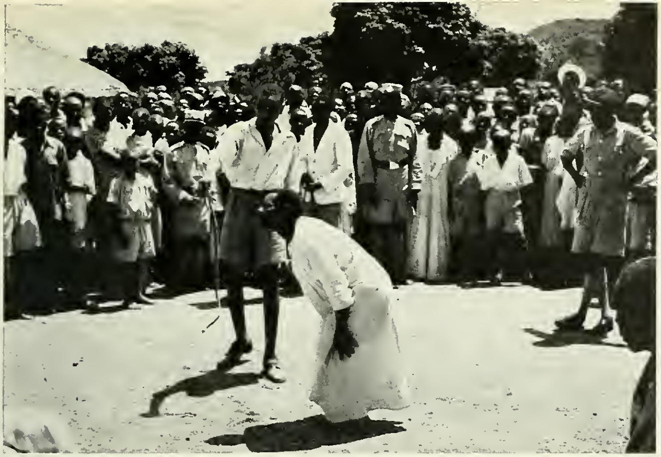


➤ THE OMUKAMA, or King, in his Throne Room, where the skins of 60 leopards cover his dais. The first king of the dynasty reigned in the 1300's. The present King's full name is Rukirabasaija (Above All Men) Acutamba (Who Can Cure All Troubles) Tito Gafabusa Winyi IV, C.B.E.

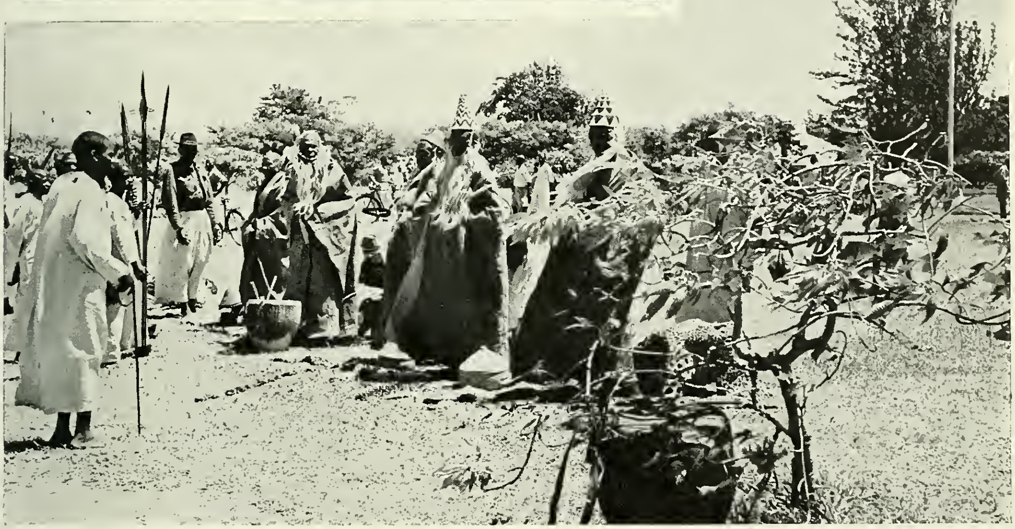
< **Following the church service** at the Anglican Cathedral, the King and Queen enter the Royal Limousine (in distance) to head a colorful procession back to the palace. The King is a member of the Church of England, whose missionaries reached Uganda in 1877. The Roman Catholic Church, which was introduced by French missionaries two years later, has had the widest influence in Bunyoro.

∨ **The King**, wearing a beard made from the hair of a Colobus monkey, makes a tour of the palace grounds to attend special ceremonies in the various huts, followed by all his Regalia Men.





◄ The Royal Snake Charmer performs for the King with a deadly green mamba and a puff adder. The King's youngest son shows his courage here by picking up the mamba, to the delight of the onlookers, while the Royal Snake Charmer peers to see that the prince holds the snake correctly.

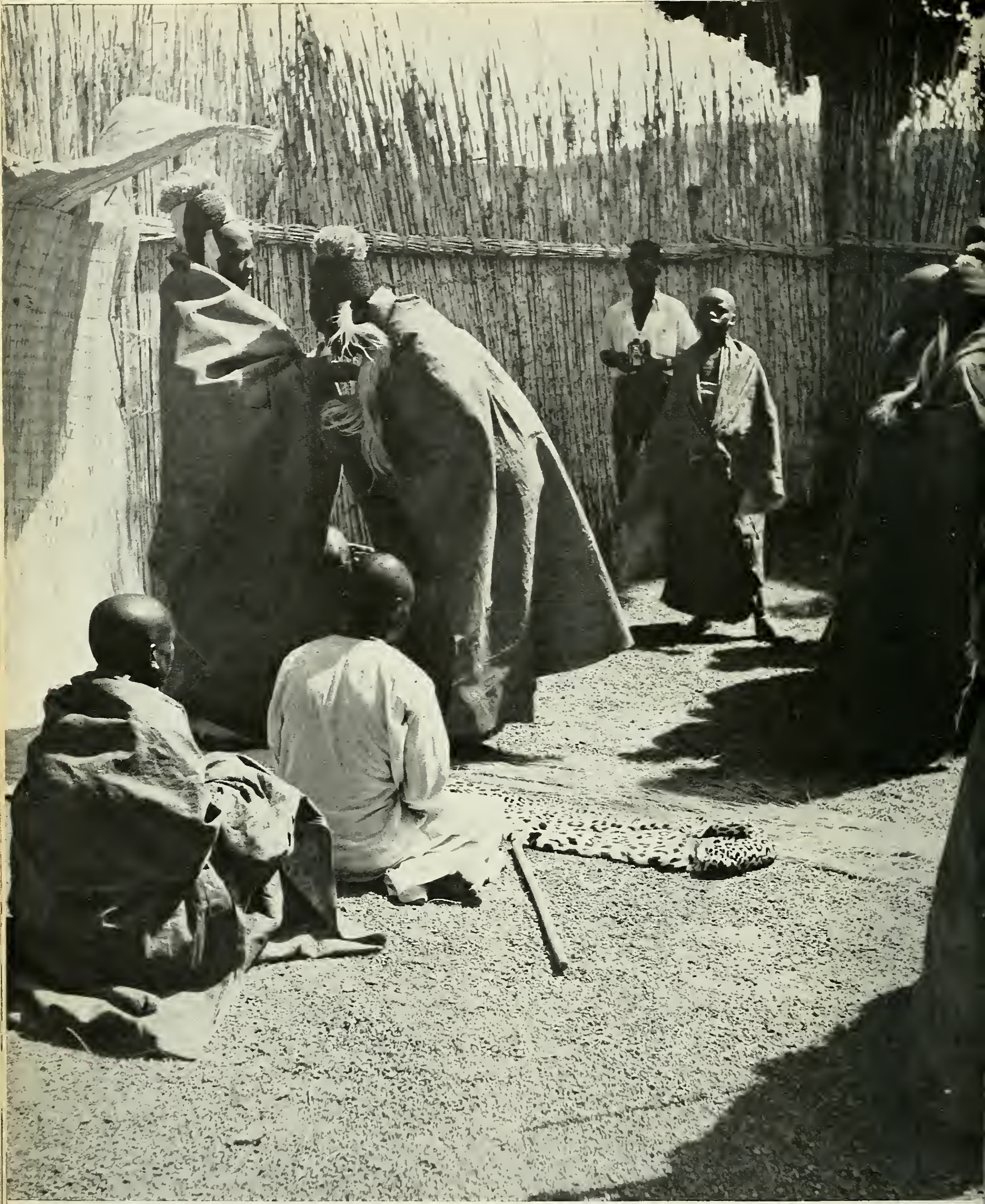


▲ Tribal chieftains and high members of the court who have the honor of wearing crowns and Colobus monkey beards await the King, each on a leopard skin rug. The King receives them in the Seventh Sacred Courtyard in a ceremony that is repeated daily during the Mpango celebrations. One man goes through the motions of accusing another for two debts, as though in court. The King disposes of the case quickly and symbolically, and the winner thanks the King by kissing his hands. Then every crown-wearer kisses the King's hands.

the King belongs to the Church of England. At his first re-crowning, the King received on his head the very headdress his grandfather, Kamurasi, wore as King in the 1860's. In his throne room, the King sat on a dais which was covered with 60 leopard skins, amid the sacred spears, bows and arrows, and other relics that have been preserved from generation to generation. Later there was a council meeting and a football game. By four o'clock in the afternoon, the dancing had started, and everyone participated far into the night in highly distinctive presentations. Trumpets, drums, and singing provided the musical accompaniment.

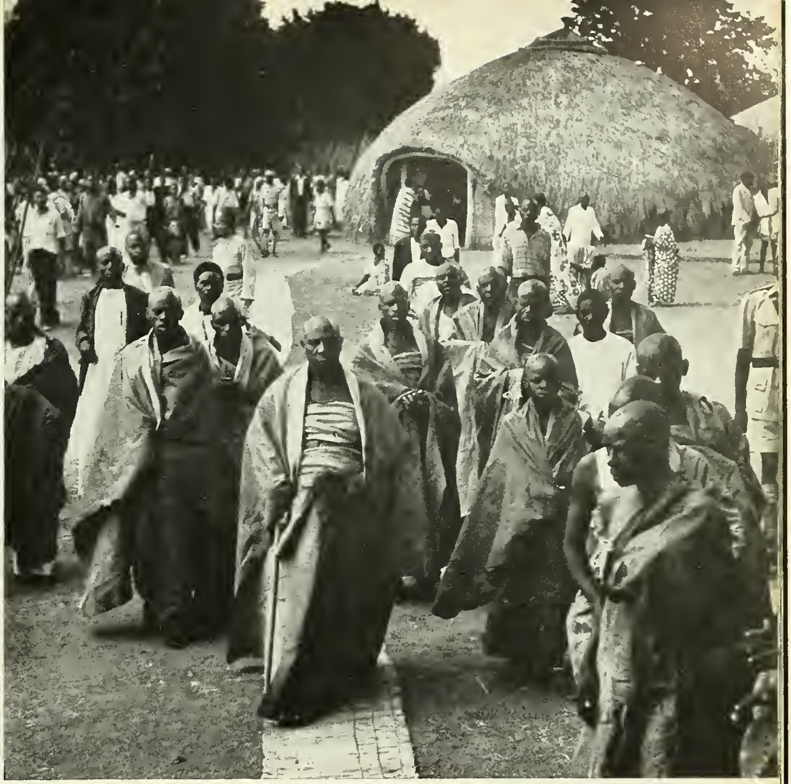
The King watched the ceremonies through the entire week and took the acclamations of the crowd with fatherly benevolence. When he was not being re-crowned, he went on tour of the thatched huts to receive and give gifts, indulging in a different ritual in every hut, each with its own significance. At other times, he sat on the palace veranda with wives, grandchildren, and concubines to review the marching school-children or watch the Royal Snake Charmer as he performed in the courtyard.

Many more photographs than are shown here were taken, because the program repeated itself for seven days. The photographer attempted to cover everything on the first day but then found himself caught up in the ceremonies. Wanting to show proper respect for the King and the dignitaries who had finally permitted the rituals to be photographed, he was obliged to continue through the week — with the result that he had seven sets of pictures that were similar except for the fact that different headdresses were used for the various re-crownings.

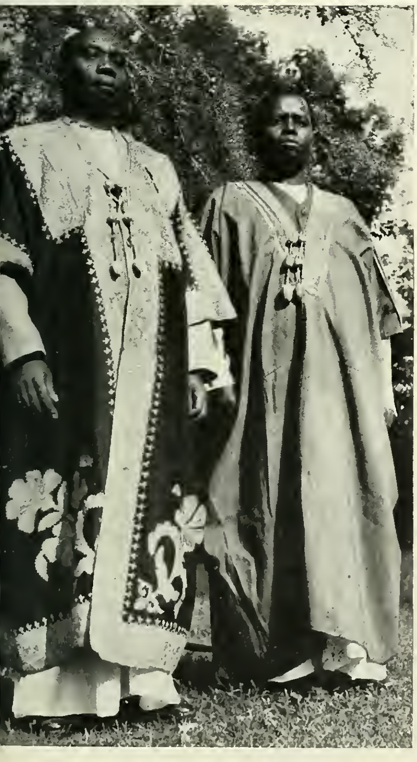


▲ HERE IN THE SEVENTH SACRED COURTYARD, a crowned tribal chieftain kisses the hands of the King, while a privileged person in the background seeks to record it for history with a modern camera. The wearing of crowns and monkey beards is a great honor bestowed only upon important individuals who comprise the Sacred Guild.

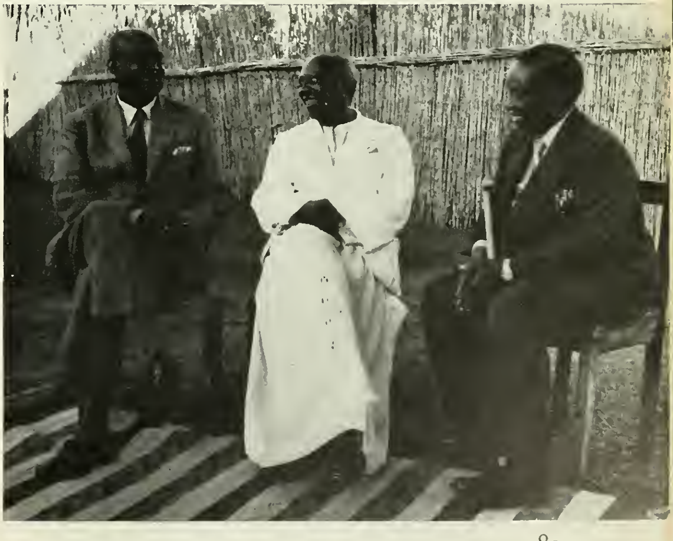
➤ SURROUNDED BY HIS Regalia Men, drummers, trumpeters, spearmen, and archers, the King files down the royal path from one hut to another. On his visits, he receives his subjects and their gifts, gives gifts in return, and performs symbolic rites.



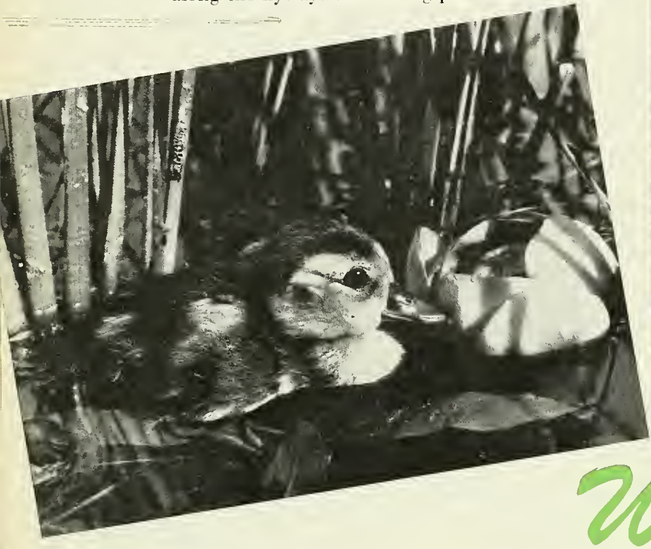
▼ THE PRIME MINISTER (Martin Mukidi) and the Chief Judge (Laurenti Muganwa), garbed in the formal robes of state they wore for the festivities in honor of the Thirtieth Anniversary of their King's ascension to the throne.



▼ THE KING OF BUNYORO (center), visiting with the King of Toro (left) and the King of Busoga (right). His Excellency George Rukidi, who is the Omukama of Toro, is a distant relative, whose ancestor, Kyebambe, broke away from the Kingdom of Bunyoro and formed his own. His kingdom has much more territory and a much greater population than Bunyoro, and only in recent years have the kings become friends. Both the Omukama of Toro and Omukama of Bunyoro were the Queen's representatives from Uganda at the Coronation.

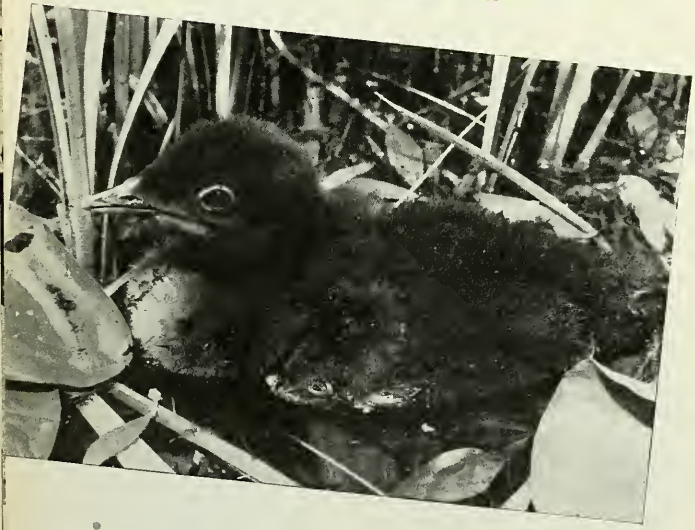


▼ A RING-NECKED DUCKLING rests quietly by a yellow pond lily. In fall, it will race along the flyways on flashing pinions.



▲ THIS NURSERY is always damp and dangerous. Though serene and lovely to human eyes, it can

Water Babie



▲ EVEN IN THIS DOWNY GARB, the young loon's streamlined profile identifies it as one of nature's more efficient submersibles.

EACH year, with the rising growth of waving cattails and dark-stalked tules, new life comes to the western marshes. Among the most appealing of the newcomers are the downy young of various waterbirds—fledgling grebes, terns, loons and ducks—all of whom must learn in a few short weeks the fundamentals of survival in the green alleyways.

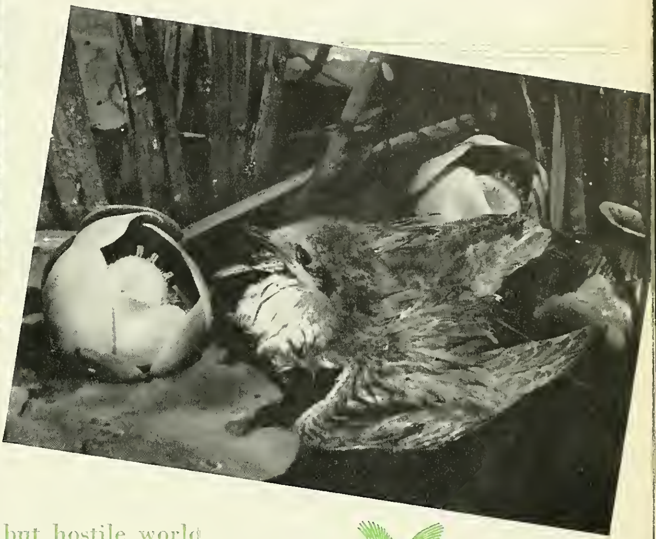
Amidst rank grasses, in woven baskets among sedges, or on floating platforms of bulrushes in secret coves, they first discover an emerald universe. Then, blue skies, white clouds, and beating rain become an accepted part of their world. They grow familiar with the white breasts of darting swallows, the glint of dragon flies' wings, and the elusive song of the Yellowthroat.

Quickly, the chicks and ducklings learn to navigate the winding waterways. Quickly, too, they learn to sense the presence of hunting wings overhead, furred shadows in cattail tangles, and voracious fish and turtles lurking at the base of the waterweeds.

At this stage, all life is learning—learning how the larvae of water beetles hide; where mayflies dip to the mirrored surface; when

mete out swift and final discipline to unwary fledglings who stray too far from their parents.

➤ The young black tern is almost ready to try its wings. Soon it will hover and dip gracefully over multi-flowered lily beds.



Downy swamp fledglings enter a beautiful but hostile world

By J. L. Blackford

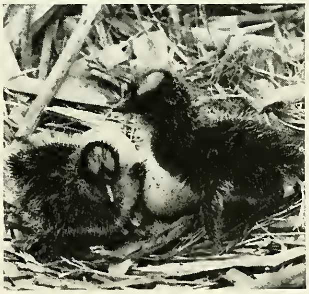
All photographs by the author (Utah and Montana)

the bur-reed seeds; where minnows school together, and always—with never an instant's lapse—the way of escape.

Escape may take the form of an underwater dive beneath a mother grebe's wing, or frantic, obedient paddling in the wake of mother duck. The loonlet may vanish into protecting reeds while parents decoy the enemy away. And the buoyant young tern may conceal itself safely beneath a wind-lifted lily pad.

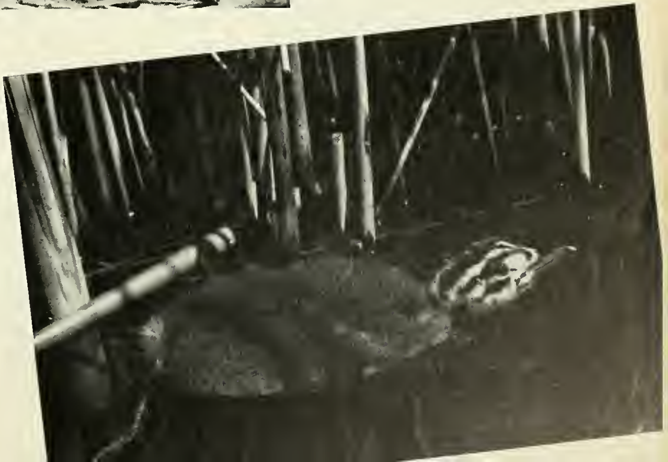
Later, the young loons venture forth on wide lake waters, convoyed by rapier-billed parents; fledgling terns launch out under dense canopies of screaming, swooping adults, and young mallards expose themselves to dabble in duckweed mats on green-mantled pools. Yet always close are unseen runways in the reeds, protected inlets, and sheltered retreats where perhaps only bill and eye may surface for a cautious glance above the watery tangle.

It is only after running the gantlet of an endless procession of dangers that a small proportion of the vulnerable water babies grow up to become hardy divers in the pounding waves, or swift-winged migrants at vast heights in the sky.



◀ Little black chicks of the ubiquitous coot are bald-headed and big-footed. Later, big feet are useful.

➤ Black and white stripes on the head of a young red-necked (Holboell's) grebe are helpful in camouflage.

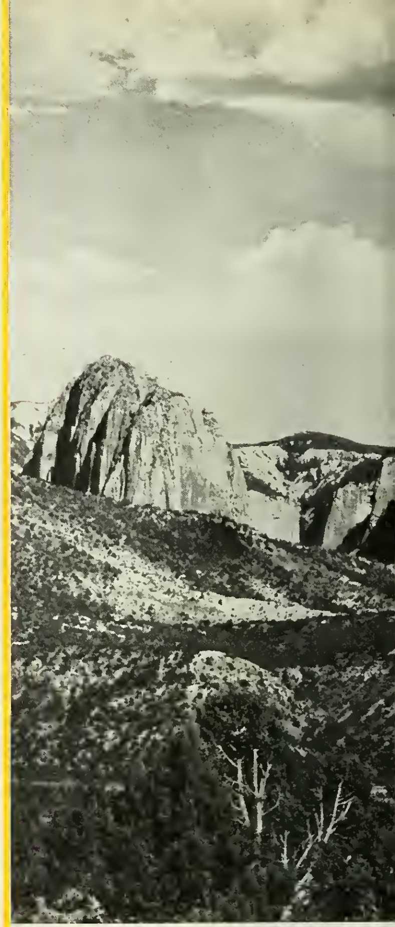


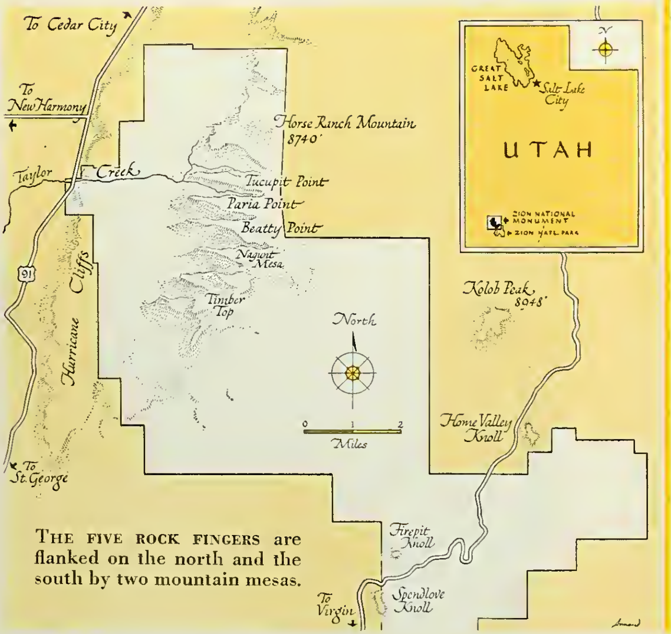
the FIVE-FINGERED CANYONS of the Kolob

A vast world of awesome beauty and variety adjoins Zion National Park, but only the most ambitious have dared enter it

By Joyce Rockwood Muench

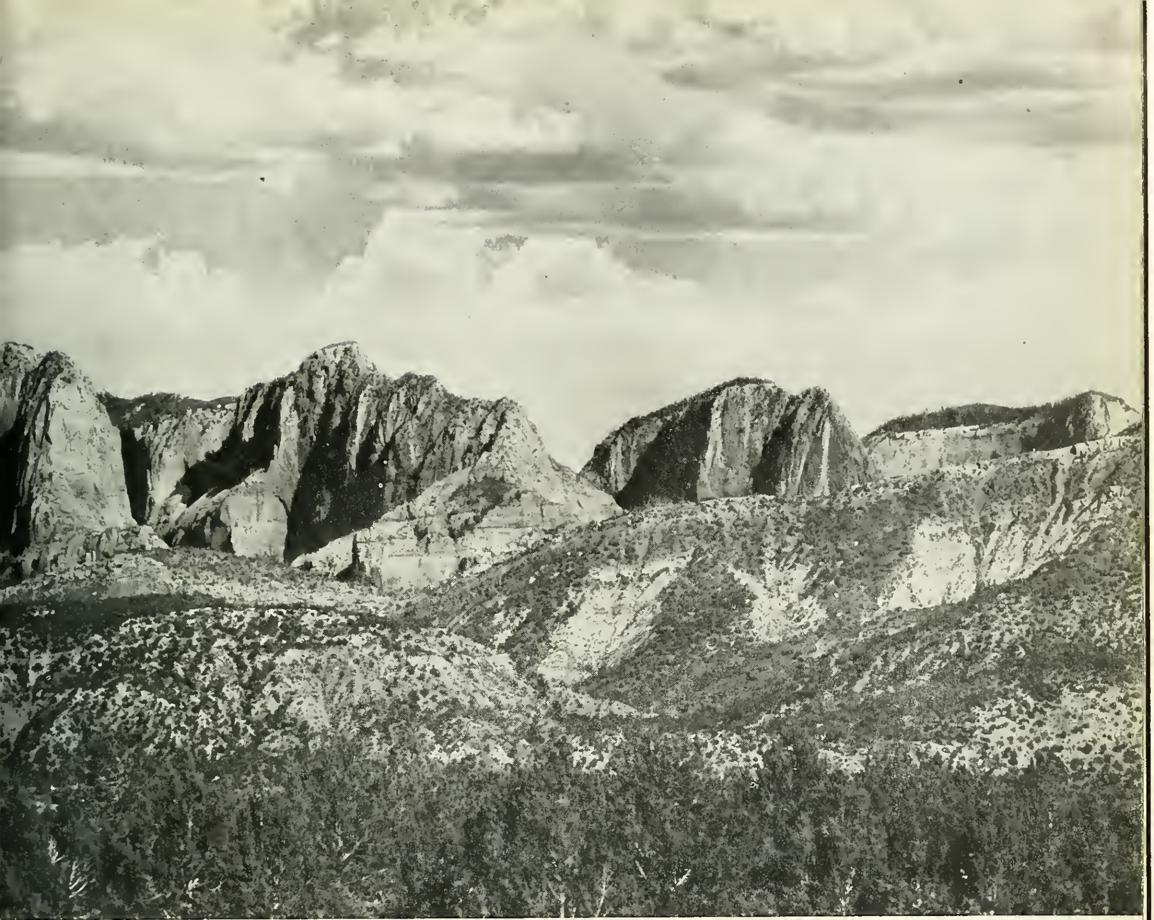
Photographs by Josef Muench




To Cedar City
To New Harmony
Taylor Creek
Horse Ranch Mountain 8740'
Tucupit Point
Paria Point
Beatty Point
Nagunt Mesa
Timber Top
91
Hurricane Cliffs
North
0 1 2
Miles
To St. George
GREAT SALT LAKE
Salt Lake City
UTAH
ZION NATIONAL MONUMENT
ZION NAT'L PARK
Kolob Peak 8048'
Home Valley Knoll
Firepit Knoll
Spendlove Knoll
To Virgin

THE FIVE ROCK FINGERS are flanked on the north and the south by two mountain mesas.

ALMOST everyone in the country has heard of Zion National Park, but the National Monument by the same name is little known. However, anyone who has driven on U.S. Highway 91, "The Arrowhead Trail," between St. George and Cedar City, Utah, has crossed a corner of Zion National Monument whether he realized it or not. Behind 6000-foot Hurricane Cliffs, which lift in a ripsaw barricade parallel to the road, the spectacular Five-Fingered Canyons of the Kolob are completely hidden. The Monument adjoins Zion Park and covers 76 square miles of canyon walls and brilliantly colored terrain. The area is well able to stand on its own merits, with its tremendous cliffs, tumbled valleys,



▲ A DRAMATIC PANORAMA that shows how the Five-Fingered Canyons got their name. The projecting spurs are of Navajo sandstone. Hurricane Cliffs (middle distance) conceal the canyons from travelers on U. S. 91.

and beautiful highlands. Recognition is bound to come.

Near a sign on the highway pointing to New Harmony, a road strikes westward, and if you travel it a few miles, you can turn and look back, to see, as if by some sort of sorcery, the Five-Fingered Canyons of the Kolob now soaring above the ridge. For some ten miles, their massive red abutments spread along the horizon. On the left flank is Horse Ranch Mountain, 8,740 feet above sea level. Tucupit, Paria, and Beatty Points are slightly lower. Nagunt Mesa lifts to the right, and a spur of Timber Top completes the impressive array.

This is the towering façade of the Monument, pillars of a wilderness temple, carved by erosion from the Markagunt Plateau into steep valleys and sudden gorges, topped by volcanic cones and the aspen-dotted highlands of the Kolob Terrace.

The view of the red sandstone promontories, jutting into the sky, is at once inviting and awesome. You can hardly expect such terrain to be easily accessible. In fact, only in two places do roads attempt to point toward the great canyons. But trails, used by early cattlemen, do climb ridges and drop through valleys to open some of the wilderness to the ambitious hiker or horseman. You can get a taste by mounting the Hurricane wall through the dry bed of Taylor Creek. Each of the canyons between the Five Fingers may be explored for a short distance. Then their gorges narrow and clam up completely. Each cut is a remote and narrow world, twisting through red-walled corridors that bear the marks of sudden storm waters. The trail skirts their mouths and makes its way southward to find a route into the back country.

To get on top by car, you follow an undeveloped road that snakes a thousand feet up from Virgin City (On Utah State 15). It enters the Monument near Spendlove Knoll and corkscrews among formations in the 20-square-mile Kolob Volcanic Field. This flow of molten rock inundated all but islandlike peaks of older sandstone. Firepit, Spendlove, and Home Valley Knolls enable the imagination to picture the tremendous rivers of lava that

▲ A NARROW BRANCH of Taylor Creek sluices down through one of the spectacular canyons of the Kolob. On the left is Tucupit Point; on the right, Paria Point. Between them the deep canyon is scissored to a mere slit before the walls join the main battlements of the Kolob Terrace.

◀ HORSE RANCH MOUNTAIN towers above an old homestead cabin in one of the canyons.

once poured out and spread with noise and tumult through valleys to a depth of from 15 to more than 100 feet. Flows have congealed over the edges of the Kolob Terrace, and sheets still cover parts of Hurricane Cliffs, extending over the flanks of Horse Ranch Mountain.

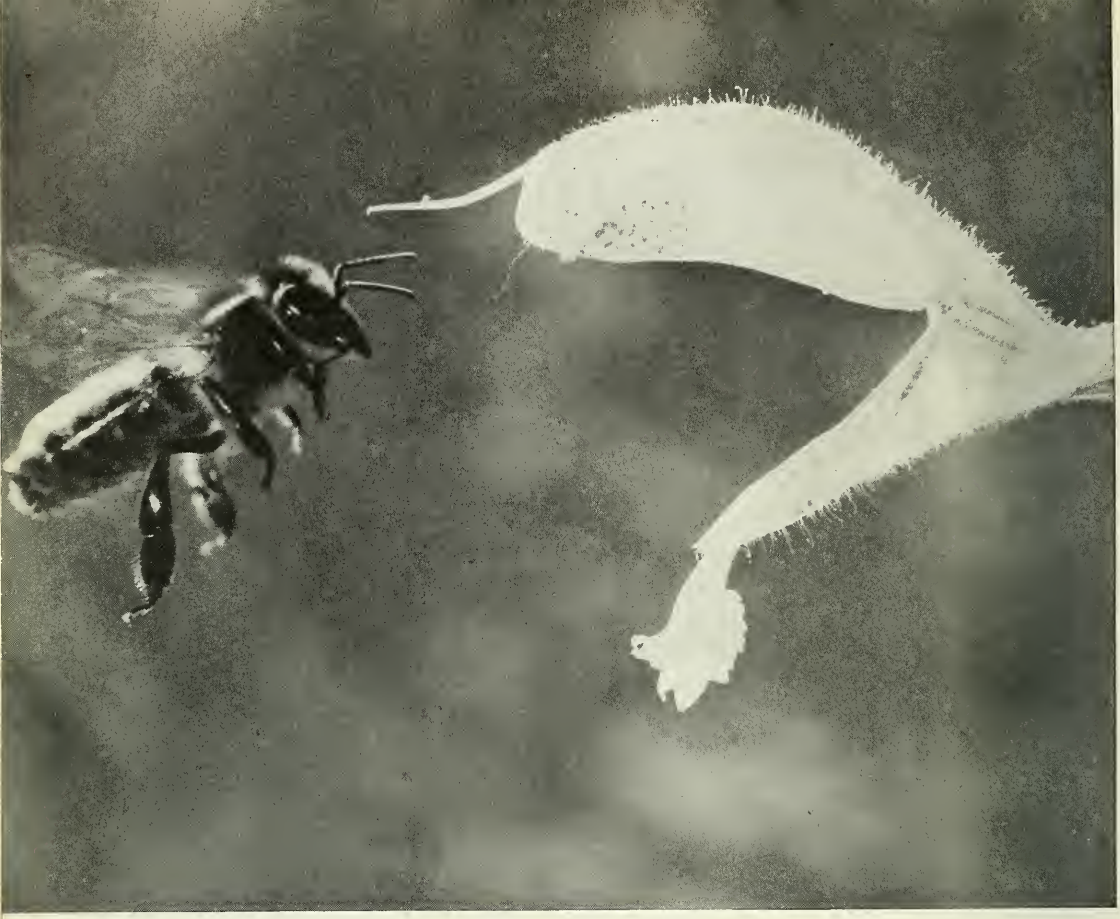
As the road climbs onto the rolling hills of the Terrace, it leaves the Monument, keeping east of the canyons, and traverses open country, most of which is more than 8000 feet above sea level. Peeled log "worm fences" make zigzag patterns on each side, and occasional flocks of sheep or cattle punctuate the grand expanse. There are patches of wildflowers in spring and golden clouds of aspen leaves in autumn, with endless reaches of blue sky, reflected here and there in marshy, temporary lakes. At the northern end of Kolob Terrace, the route finds a way down over the Hurricane Cliffs to Cedar City.

Zion National Monument will appeal most to those who are willing to leave the highway and explore casual roads or rocky trails during the brief summer season. This is a wilderness area, completely undeveloped. No accommodations or campgrounds will be found within its borders, and the visitor must carry his own water.

Information about trails can be secured by writing to the Superintendent of Zion National Park, Springdale, Utah.

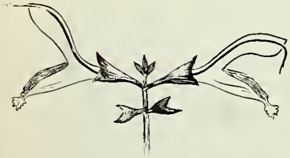
▲ **Sheer sandstone walls** rise hundreds of feet above a deep cut where Taylor Creek sends its intermittent flow westward from the Terrace.

◄ **Looking over** toward Zion National Park from Lava Point. This outlook in Zion National Monument gives a splendid distant view of the white walls of neighboring Zion Canyon, deeply eroded and topped with forests.



▲ HUNTING NECTAR, the bee heads toward the open sage flower to make a six-point landing on the special stage.

A Bee and a Blossom

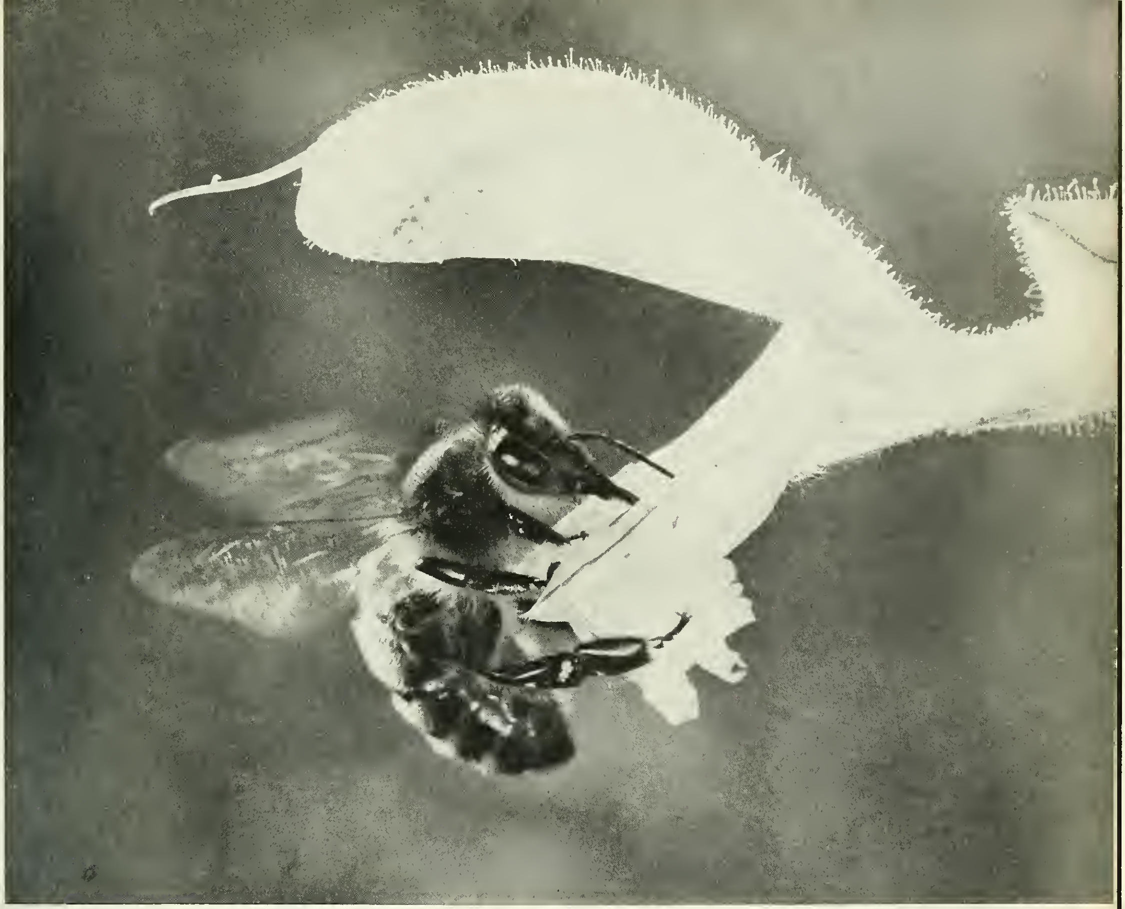


▲ THE YOUNGER FLOWER at left, which is *shedding* pollen, has the stigma sticking straight out, and the bee can enter the flower without touching it. In the older flower at right, which is *receiving* pollen, the stigma has dropped to a position where the bee will touch it upon entering.

A remarkable series of photographs showing more clearly than the human eye can see one of the most unusual examples of insect pollination

Photographs by HERMANN EISENBEISS

Text by HENRICKS HODGE



▲ **Struggling** for a hold on the lower lip of the corolla, the bee probes with its tongue for droplets of nectar.

THE flower shown in these photographs is the common European sage, *Salvia glutinosa*, first cousin of the savory sage of the kitchen and of the ornamental scarlet sage of our gardens. The mechanism it has evolved to ensure the transfer of pollen by a bee is a beautiful example of the delicate interdependence that has been achieved through the ages between certain insects and flowering plants.

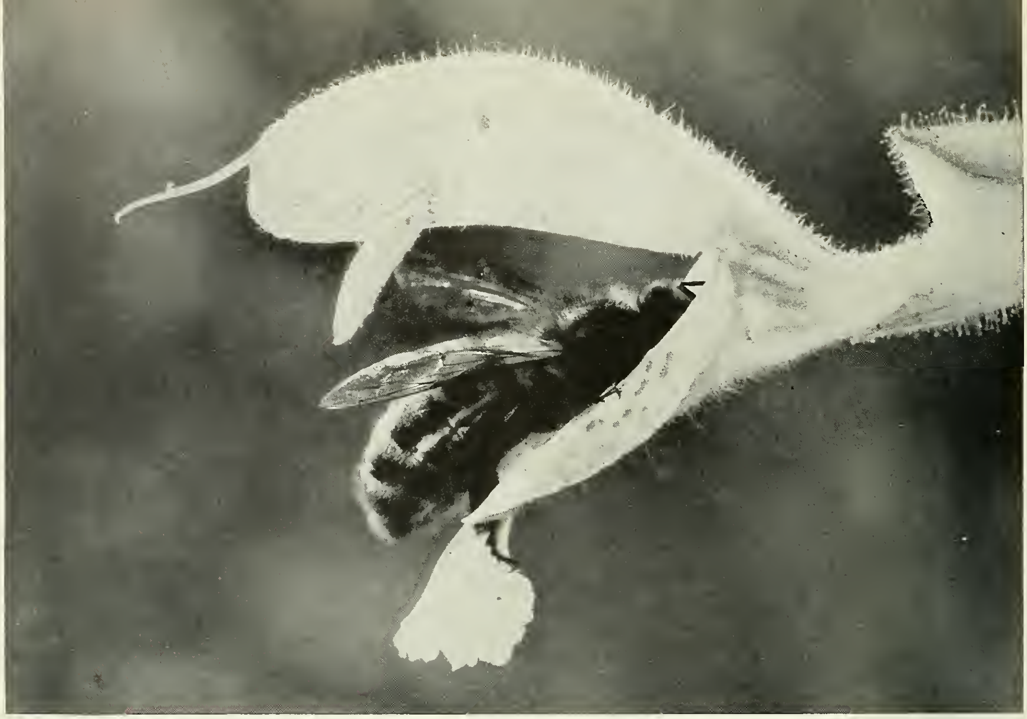
These plants and the insects that pollinate them have evolved together. Indeed, the geological record indicates that flowering plants burst onto the prehistoric scene almost at the same time as certain modern insect groups that today serve them.

These are not like the profligate plants that produce large quantities of pollen for random distribution by the wind. They depend instead upon various specialized developments. Their pollen, instead of being dry and smooth like wind-borne pollen, is generally roughened by microscopic spines or is smeared with a kind of glue enabling it to become attached to the legs or bodies of insects. And the blossoms are for the most part showy and fragrant, for they must advertise themselves to their insect friends.

The best known of all insect pollinators are the many kinds of bees. Honeybees, with their hairy legs and curious "pollen baskets," are especially well fitted for carrying pollen, and their long tongues can probe for nectar in the most difficult flowers.

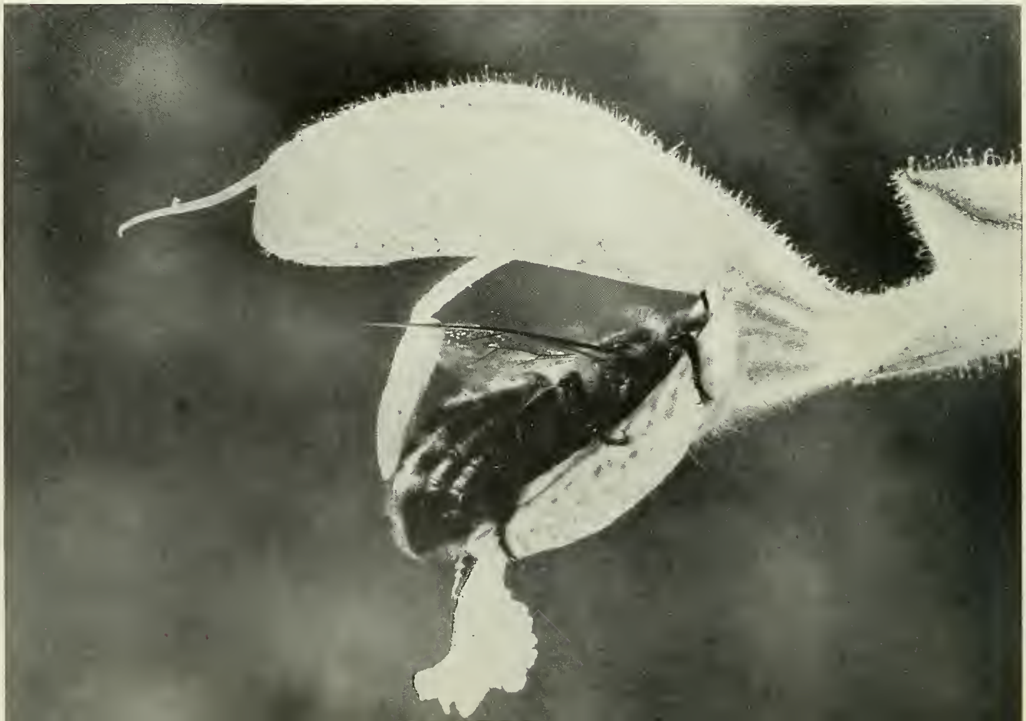
Spurred on by an instinctive desire for both pollen and nectar, they work from dawn to dusk, visiting large numbers of blossoms of the same kind of plant. Thus they are of utmost value to certain species whose flowers cannot be pollinated in any other way.

Many persons do not realize that some flowers contain moving parts to make certain this vital process. The sage, like many other plants, would face sudden extinction in a world without insects. The first drawing shows two flowers in the two stages of development required to ensure cross-pollination, and the photographs show the mechanism in operation.

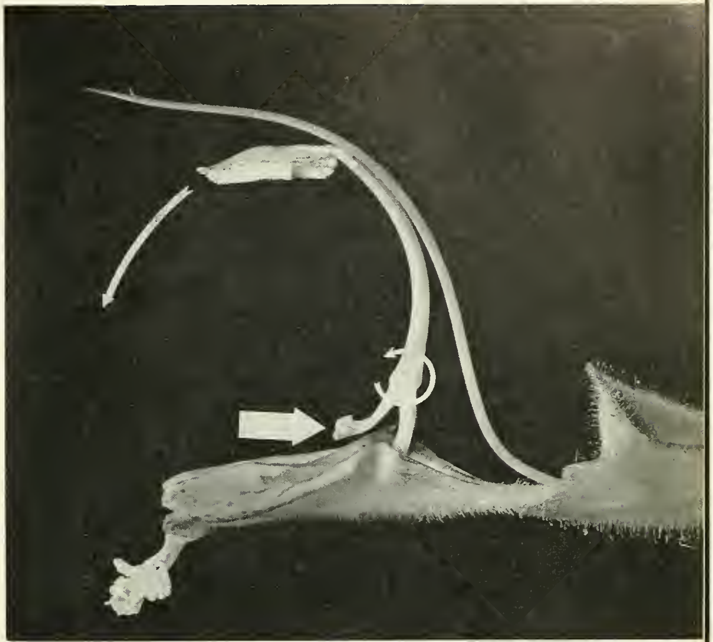


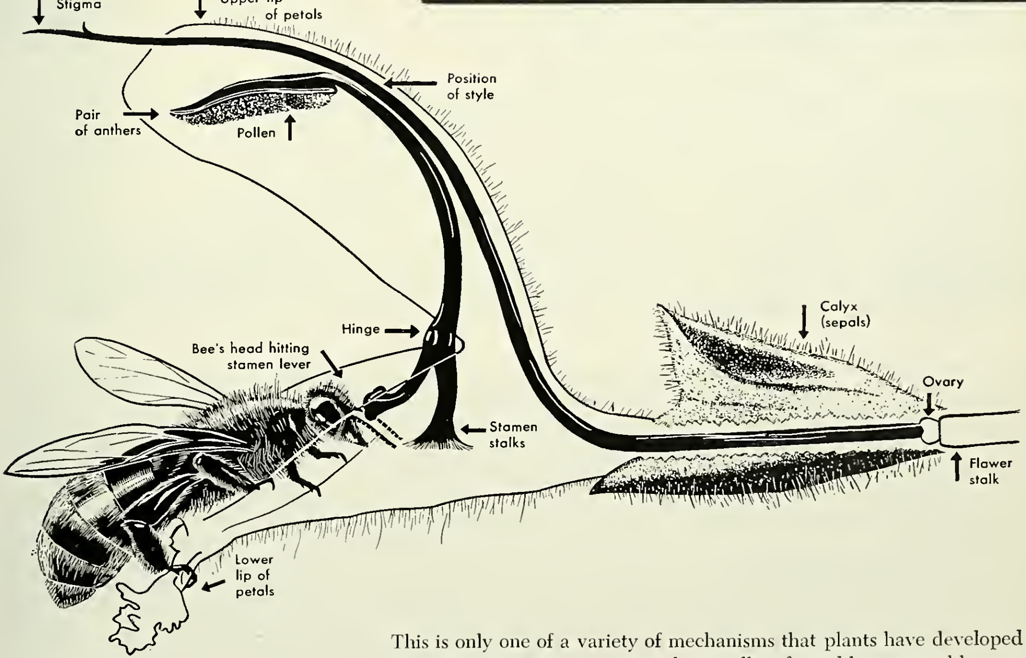
▲ FINDING LITTLE if any nectar on the lip, the bee explores deeper into the flower's throat, at the base of which lie the tiny glands that secrete the sweet liquid. In this process, the bee activates the mechanism that brings the anthers, loaded with pollen, down toward its back. Notice the tongue-shaped anthers above the bee.

▼ HERE the pollen is being pressed against the bee's back. The manner in which this mechanism operates is explained in the following photograph and drawing.

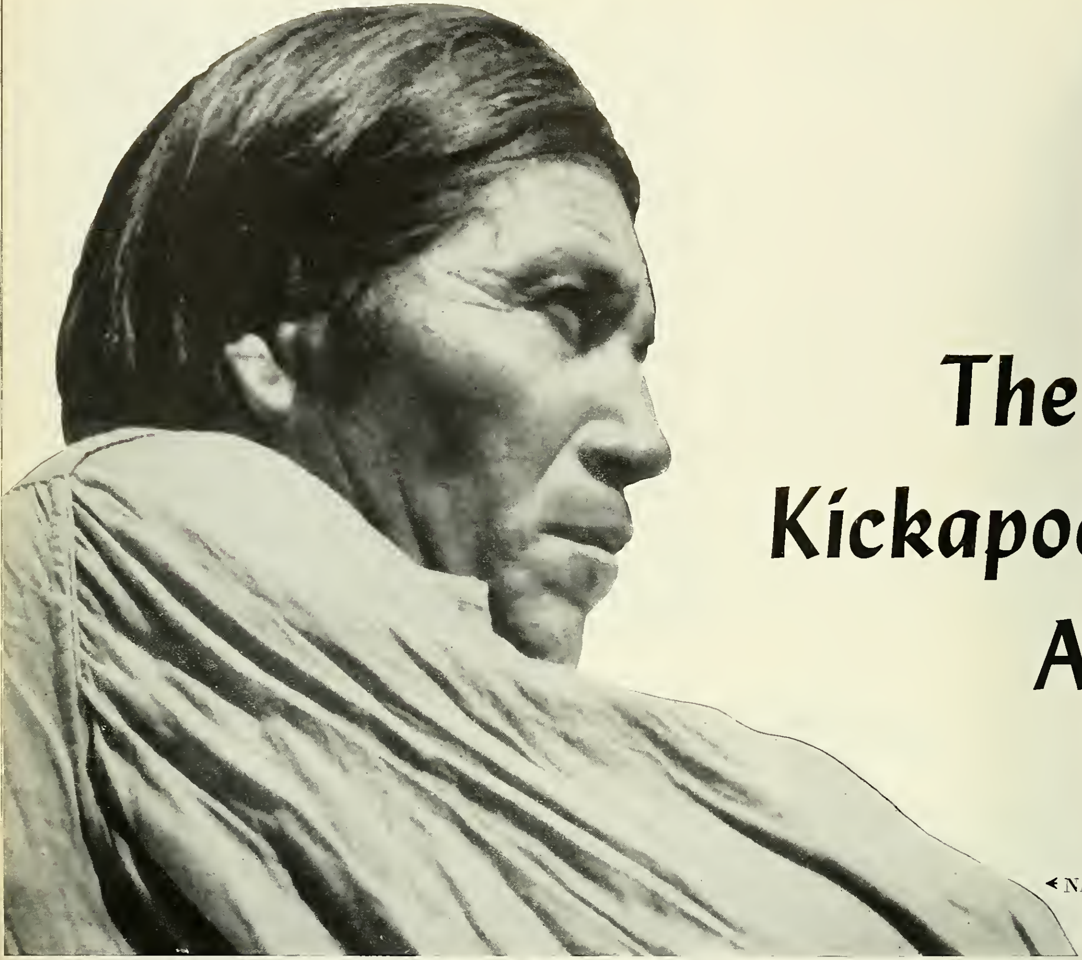


➤ HERE part of the flower has been cut away to show the mechanism. When the bee's head pushes against the lever of the stamen as shown by the heavy arrow, a hinge (indicated by the circular arrow) causes the pollination mechanism above to rock downward. The pollen-shedding anthers (upper left arrow) touch the bee's back, to which the pollen becomes attached. The bee then emerges and, upon entering a flower whose stigma has dropped into the receiving position, deposits the pollen. Once on the stigma the pollen germinates. The male reproductive cells, contained within the pollen grain, are then carried by the germinating portion down the style to the ovary where they join with the female reproductive cells, causing fertile seed to develop.




Stigma
Upper lip of petals
Position of style
Pair of anthers
Pollen
Hinge
Bee's head hitting stamen lever
Calyx (sepals)
Ovary
Stamen stalks
Flower stalk
Lower lip of petals

This is only one of a variety of mechanisms that plants have developed to trap insects into carrying their pollen from blossom to blossom. Orchids are especially ingenious in their pollinating mechanisms, and study of them by Charles Darwin resulted in his celebrated work, *Fertilization of Orchids*, published in 1862. Several outstanding examples were illustrated in an article by Carl T. Ramsey in the October, 1938, issue of NATURAL HISTORY Magazine.



◂ Nani-Nen

The Kickapoos AR

If you want to study Wisconsin Indians, you'd better go down to Old Mexico. You'd also better think twice.

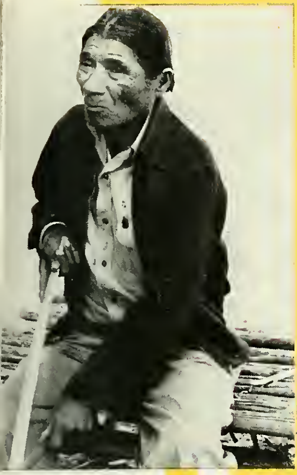
When we went to find out about them, the 387 displaced Indians of the Kickapoo tribe whose ancestors wandered from Wisconsin to the Mexican village of Nacimiento made it clear that visitors were not wanted. They had burned down two schools that the Government had put up for them and refused to let a doctor on their reservation. The Government had built a model dispensary at a near-by settlement, but they would not enter it.

They enjoy the singular privilege of being citizens of both the United States and Mexico, but they have it in for all outsiders. Their chief once said to President Cardenas: "You are head of your people; I am head of mine. I don't bother you; don't you interfere with us." Their reservation is their ivory tower.

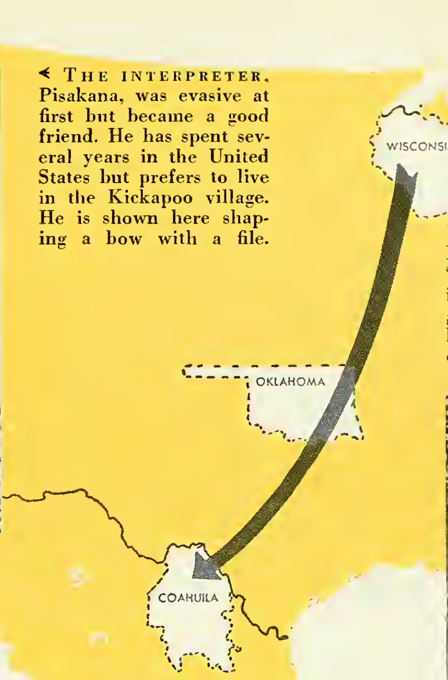
Our field trip began in the town of Muzquiz, on the highway from Eagle Pass, Texas. There we met a Kickapoo named Pisakana. He was extremely evasive, but we set out with him for the village late in the afternoon. The road to Nacimiento was a forewarning of what we might expect. It was rough, unpaved, with deep ruts and sharp jutting rocks that could easily rip the bottom out of the car. Halfway to the village, dusk overtook us. The road continually forked and branched, and many times we had to get out to cross a river bed or open a cattle fence.

Even before we reached the village, the gas gauge read Empty. Night was falling. In case of a hostile reception, we would just have to make the best of it.

As we came into the village, we heard rifle shooting. A Kickapoo sitting at the door of his "wigwam" had jumped up and was firing his gun into the air. When we tried to see what he was shooting at, we



◀ THE INTERPRETER, Pisakana, was evasive at first but became a good friend. He has spent several years in the United States but prefers to live in the Kickapoo village. He is shown here shaping a bow with a file.



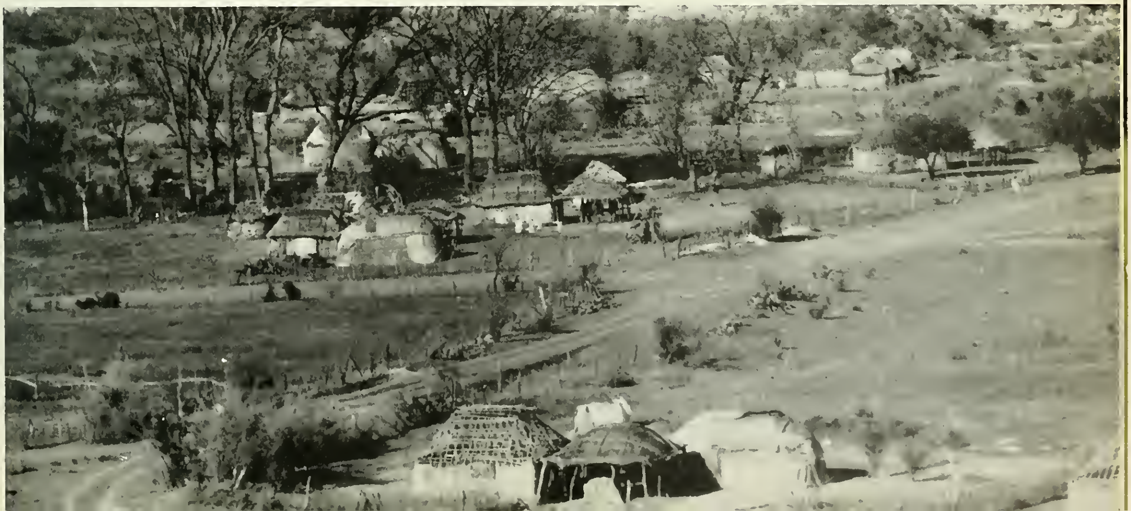
▼ CHIEF PAPIKWANO once told President Cardenas of Mexico: "I don't bother you; you don't interfere with me." Cardenas gave the Kickapoos agricultural help. Prosperity followed, but drought reduced them to poverty.

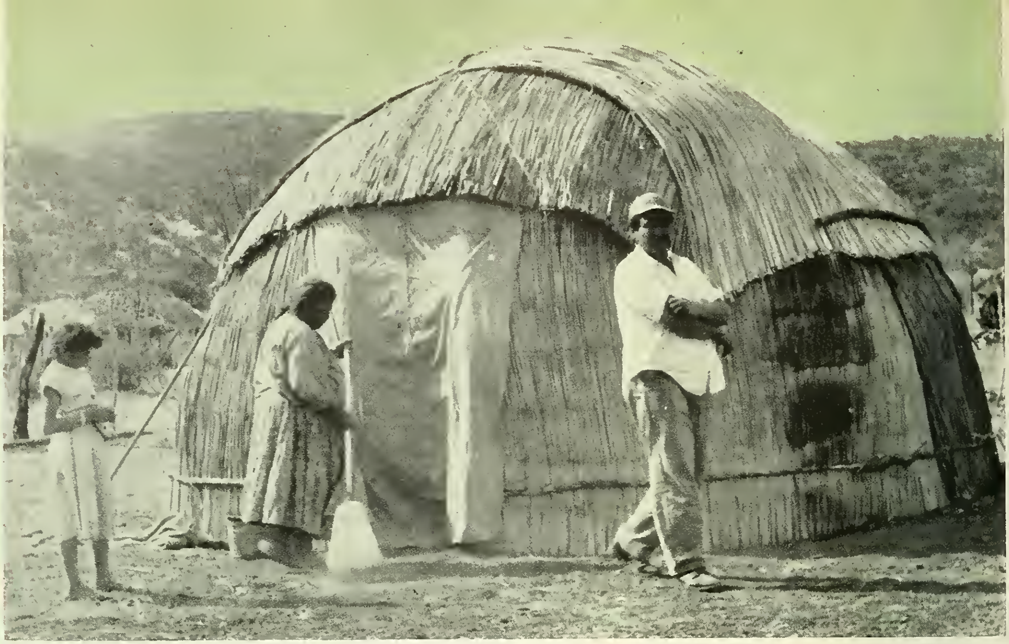
TILL KICKING

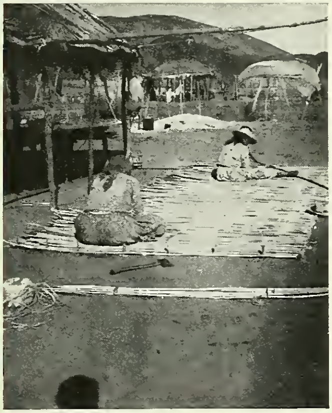
After migrating clear from Wisconsin to a secluded valley in Mexico, these most primitive surviving Woodland Indians are still struggling to keep their tribal identity

By FREDRICK A. PETERSON *and* ROBERT E. RITZENTHALER

▼ THEIR VILLAGE stands near the foot of the Sierra Hermosa de Santa Rosa Mountains, in the state of Coahuila. Latest threat to their existence is a five-year drought that destroyed their crops and thinned the vegetation.



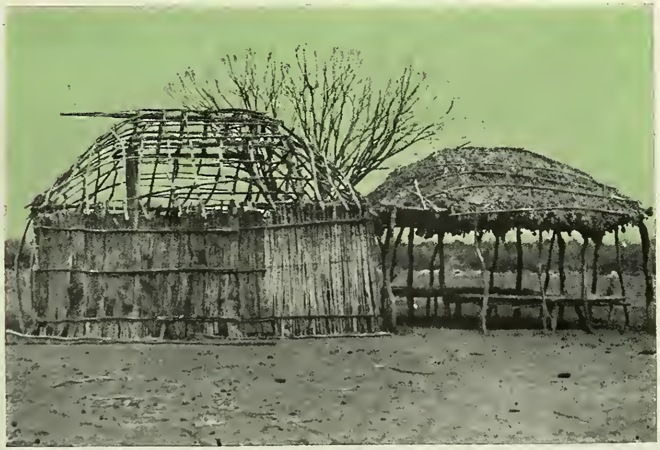




▲ **The Kickapoo house** is shut by a canvas curtain. To enter, you merely walk in without announcing yourself. The house and space around are always neatly swept. Reeds up to 25 feet long are used for covering the house.

◄ **It is** the women's job to make the house. The people sleep on raised benches.

▼ **A summer house** without a roof. On hot nights, the Kickapoos sleep in the little arbor in front of it.



noticed that the moon was eclipsing. He was just trying to keep the moon from being swallowed, like any good Kickapoo.

Pisakana took us to Chief Papikwano, a wise old Kickapoo with a withered leg and a wonderfully seamed face. In a two-hour powwow, we told the chief that we came from Wisconsin, where his tribe had once lived. We were interested in visiting his people because their ways were fast disappearing.

He said that they certainly were and that our schools were to blame. "Our children learn your ways and forget our ancient customs," he said. "That is why we don't want to have you here."

We said we were not here to teach but to learn.

Chief Papikwano answered: "Our God created men with only one tongue, one language. Later He gave them many other tongues. Men do not understand each other now, or their beliefs, because there are many languages. You can't speak our language, so you can't understand us."

We answered that he had men in his tribe who could speak our language. We wanted permission to stay and talk with them.

In interpreting, Pisakana injected sly comments of his own and harangued us at length about sad details of Kickapoo history, for which we as white men were responsible. Also, the chief liked parables and used subtle phrasing. However, we were finally given permission to remain. We asked for a place to stay.

"You fellows go back to Muzquiz and come back tomorrow," the chief said.

We said that we were out of gas. The chief then sent for a jolly, chubby squaw, Izcupethuqua, who was to be our landlady. She had an empty "wigwam" because she had lost her husband and Kickapoo belief required that she abandon it. If we weren't afraid of wandering spirits, we could occupy it.

We were led through pitch darkness with rifle shots echoing from the hills all around us. The wigwam resembled a haystack. It was made of poles and cattail reeds, forming a domed ceiling about ten feet tall. Sleeping platforms extended along three sides of the house. The squaw put some bulrush mats down, brought two quilts, and left us in total darkness.

The night was long and very cold. It was broken by rifle shots, peculiar whistling, drunken shouts, and what sounded like war whoops.

Scarcely Chatty

The next day we had long talks with the chief about Indian ways and copied several old documents in Spanish defining the Kickapoo land-grants. The chief took great interest in a picture we had of a Thunderbird Drum. "This drum is played by us during the rain dance," he said. "Our God listens to it and makes it rain. The birds on the drum are Thunderbirds, which go and bring the rain."

Pisakana was growing more friendly. That night, he came over to invite us to his house for supper. The chief, too, was thawing out a bit. Seeing that we had no fire, he called for a woman to make one for us. All the same, we couldn't get him to tell us about their customs and beliefs.

Many people think that the student of native cultures simply sits down under a tree and has all the information poured into his ears. Some of the Kickapoos did say they would talk if we took them several miles out of town. Even then, evasion was frequent. When we asked about ceremonial things, the informant would say: "Well, I don't know much about those things." Some of the information most eagerly given turned out to be false.

The Kickapoos constantly put us on the defensive by reminding us that we were not as able as they were in hunting or walking. It was irritating to be treated like undesirable children, but we learned to see the funny side of it.

Chief Papikwano harangued us: "If you hadn't come in and killed off all the deer without needing them for food, there would still be plenty. It was at the time when you were finishing off the game that you began to build zoos and museums to keep what was left. You are scared now that everything is going to be shot off, so you make laws. If you had been considerate

▲ ALL KICKAPOO MEN are expert with the bow and arrow. Their chief job is to bring home meat.

➤ A MINIATURE BOW is tied to the baby's cradle, and the growing boy is not considered dressed unless he has a bow and arrow in his hand. This is the son of Chief Papikwano.

and paid attention to natural laws, there would still be plenty of game. You came with big shotguns, with big barrels and lots of shot, and knocked down seven, ten, twenty birds at one shot. You didn't kill them for food but to put feathers on women's hats. This is not obeying the laws of nature.

"You poisoned the water holes of the buffalo and killed thousands for sport. You took only their hides to make rugs, leaving all the meat behind to rot. If it were not for all this, there would still be plenty of meat today. Now you make laws. You say we should keep them. The Indian has his own laws."

To enter a Kickapoo house, a visitor never hesitates. He just lifts the canvas door cover, steps inside, and sits down on the floormats. If you visit a Kickapoo at mealtime, he automatically hands you a plate and spoon and motions you to the cooking pot—whether he knows you or not. Payment is never asked. They consider that the Great Spirit gave food to all men, to be shared alike.

The Kickapoos speak an Algonquin language related to the Fox, Sauk, and Potawatomi. Very few of them speak Spanish or English, though probably more do than admitted it to us. They would often visit us and never say a word, but we were certain they understood what we were saying.

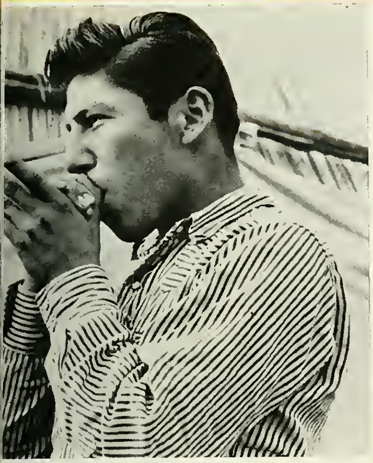
When they lived in Wisconsin during the 1600's, they were a seminomadic people. White settlers gradually pushed them southward to Illinois, Kansas, Oklahoma, and Texas. The Civil War forced them into Mexico. The tribe was then split by action of a certain U. S. Major McKenzie who, disregarding international agreement, went into Mexico and captured most of them. These were put on a reservation at Shawnee, Oklahoma, where half of them still live today. However, the other half became discontented and returned to Mexico. The Mexican and U. S. groups of Kickapoos are constantly in touch with each other. The Oklahoma Kickapoos come to Mexico in large numbers for ceremonies, dances, and games. They consider Mexico their religious center. The Kickapoos are allowed to pass freely back and forth across the border but pay no income or property taxes. Their U. S. "Passport" is a photostated copy of this 123-year-old military order:

> *This is to certify that the familys of the Kickapoo Indians, thirty seven in number, are to be protected by all persons from any injury whatever, as they are under the protection of the United States, and any person violating shall be punished accordingly.*
>
> Wm. Whittlee,
> *Mj. 2nd Reg. Inft.*
> *Fort Dearborn, Sept. 28, 1832*

Kickapoos put the good of the tribe above any individual interest. There are no class or caste divisions, and everyone is related to everyone else. Wealth carries no prestige. That comes from leadership, sacred knowledge, skill in handicrafts, or hunting ability. They all belong to one of four clan-like religious groups called: Buffalo, Universe, Heaven, and Flowering Fruit. Each Kickapoo also belongs to the Black or White Moiety, or "half." This division is made for the purpose of choosing sides in religious games.

Their independence and lack of co-operation is famous. They told us that they did not want their children to become as shameless, dishonest, and hypocritical as white men. Despite their contempt for doctors, they seem to be healthy. However, infant mortality is shockingly high, reaching 30 per cent. Their medicine men treat sickness with herbs, blood-letting, sweat baths, and magical techniques.

The Kickapoos claim they need no help in policing themselves, for crime is almost non-existent. Theft and homicide are rare. We never hesitated to leave our wigwam unguarded when we went for walks



Young unmarried couples talk to each her at great distance by whistling. The ders consider this a dangerous form of rtation, though everyone who knows the histle language can listen in.

Young Kickapoo girls help their mothers the house and bring water from the ring. They also herd cattle and gather ewood.

▲ The Chief's wife, Na-nat-chee-ha. Her mother was said to have been a Comanche kidnapped in battle.

➤ A Kickapoo child holding a fat little puppy.

or trips. Drunkenness, however, is a serious problem. We were often awakened at night by howling Indians. When a drunk became violent, his fellows would tie him hand-and-foot and leave him lying on the ground until he sobered up.

Brief Prosperity

In the 1930's, President Cardenas gave them mules, cows, wheat, seed, plows, rice, sewing machines, shovels, clothing, shoes, horses, jackets, and overalls to a total value of over 1½ million pesos. They became agriculturists in earnest. Even the chief was seen behind a plow, and within a few years they had become practically self-sufficient. They planted apple, pear, and peach trees, and harvested big crops from the nut groves. They began raising white-faced cattle. Their horses increased. Irrigation canals were dug all over their village and fields. They started traveling to near-by towns to sell part of their grain and vegetables.

This pastoral paradise ended about six or seven years ago when a drought changed this rich area into a dusty semidesert. The irrigation ditches haven't had water in them for six years. The fruit and nut trees have all dried up. The Kickapoos had to sell their cattle and horses and migrate to the United States each spring and fall to earn enough to feed their families. They work as harvest hands, gathering Texas spinach, Idaho potatoes, Washington apples, Alabama cotton. They even go into Illinois, Wisconsin, Michigan, and Ohio.

We sat in at a powwow between the chief and several Mexican representatives over the question of federal credit to enable the Indians to restock their ranges.

"We don't know much about credit," said Chief Papikwano. "That isn't our system. President Cardenas gave us nearly 2 million pesos worth of material. If this new President will give us aid, we will accept it. We don't know much about this meeting you're having. We have to meet together and talk about it first. Right now, I can't tell you what we are going to do. It might be better if I could go to Mexico City and talk to the President personally. I want to tell him what Cardenas did for us and tell him what we need and see if he will give it to us."

We discovered a rare and interesting system of communication among the Kickapoos, which we called courtship-whistling. If a boy wants to summon his girl, he holds his two hands in front of his mouth to form a wind chamber and whistles to her. By whistling in cadence with the phrases, they can carry on conversations at long distances.* The whistling begins around dusk and continues until 10 or 11 o'clock. The messages are mostly standard phrases, such as: "Come on out!" "Wait a minute," or "What's keeping you?" But longer messages can be exchanged. The whistler can often be identified by his whistle, and since anyone knowing the whistle language can understand the message, the young people must be careful what they say. The old folks cannot understand the language, and they oppose it vigorously, protesting that it leads to sexual laxity and keeps the young out too late at night. They approve of the older courting with the flute.

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* A system of whistle-language is also used in the Canary Islands. See Annette Guest Very's article "Talking by Whistling," in Natural History Magazine for October, 1946.—Ed.

Kickapoo parents still wrap their babies on cradle-boards at birth. But they are very fond of their children and treat them with great kindness. Chief Papikwano told us that child education and punishment are combined.

"All knowledge comes from God. The knowledge of one's actions—past, present, and future—is the highest knowledge. The way we study things is to paint the face with ashes and to fast. One is then given wisdom by the Great Spirit. More is not necessary. If a child goes wrong, ashes are put on his face, and no one may give him to eat. In this way he achieves wisdom. When a man paints his face and goes out of the village and fasts for a couple of days, he receives visions, which tell him of the future for himself, his people, and even other peoples. This is the only true knowledge."

Parents teach their children how to work with tools, materials, and techniques. At religious gatherings, the men are harangued by the chief and by medicine men on religion, tradition, and custom. The Kickapoos feel that they know all that is necessary.

The women do most of the work in the village. The main duty of the men is to provide meat for the household. Several times, returning hunters brought us cuts of deer and peccary. When they are not hunting, the men pass their time visiting one another.

They procure minor necessities at a small store in the village, but their big shopping center is the near-by town of Muzquiz. A daily bus service has been established by a Kickapoo from Oklahoma who became wealthy from oil leases.

Most of our attempts at taking photographs were blocked, owing to the belief that one can use a person's picture to harm him. We were also visited by a delegation who had gotten the idea we had a wire-recorder. Although we assured them this was not true, most of them were afraid to sing for fear of having their voices "captured." They suspected us of having a hidden mission. But when we faithfully complied with all their rules and never tried to do anything without permission, the watch was gradually relaxed.

One day, a ragged Mexican—a missionary of the Presbyterian faith—showed up in the village and began carrying water from the spring to the huts for a trifling fee. He slept on the ground, tried to gain favor, and passed out religous leaflets. But he was forced to leave the village the next day. No missionary or priest has been allowed to establish a mission or church in the village.

Beliefs and Ways

Their big religious ceremony, called "New Year's" is held on an indefinite date in February. A watchman is posted on a near-by hill to watch the skies, and when he sees lightning or hears thunder, he shoots off his rifle and shouts: "The New Year has begun!" The dead are then given directions for reaching heaven and are talked to by means of magical flutes. A feast is given for them, in which puppy dogs and deer ribs form the main dishes. A sacred fire is kindled and taken into one of the houses, where it is kept secretly. If it goes out, the whole tribe must perform acts of severe penance.

When a boy is born, a miniature bow and arrow is placed on the cradle, and any youngster is considered undressed without a bow in hand. He shoots at targets on the ground, such as balls of cactus fiber and rolling oranges. At the tender age of ten, he is taught the use of the .30-30 rifle. After puberty, and when the lad kills his first deer, he is considered to be a man and may marry.

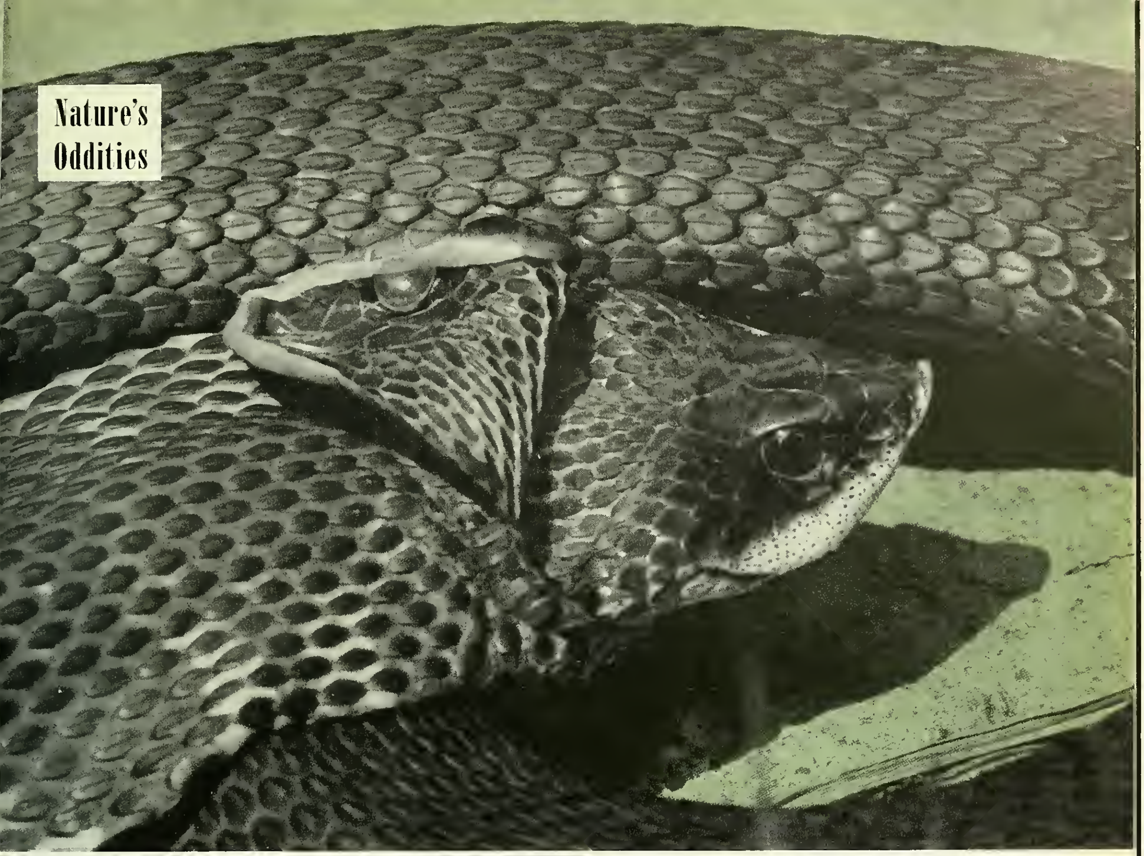
The hunting of deer is of the greatest religious and economic significance. To be a good hunter is to be a good Kickapoo. The whole village used to go on a big hunt each year. We were told that they once killed 1400 deer. Now, however, there are too many fences and prohibitions, so they go out in small groups. They condemn the ranchers who forbid them entrance. "If you call the deer your property, where is your brand on him?" they say. "You did not raise him. God raised him and gave him to us, so he is ours. We respect your cattle because you have your brand on them, but let's see your brand on the deer."

Chief Papikwano one day solemnly asked us to inform the President of the United States of this petition:

"That the President of the U. S. should order U. S. citizens holding land in Mexico to let the Kickapoo enter into their ranch lands bordering on Kickapoo territory, as the deer are sacred to the Kickapoo. The deer are our sustenance, our clothing, our offering. Without deer, we lose everything: our habits, our traditions, our ceremonies, everything." There was a friendly Mexican, they told us, who allowed them to hunt on his land, and he therefore always had good crops and plenty of rain. But his son after him forbade the Kickapoos to enter his land. Now his farm is completely dried up, and he is going bankrupt.

The old chief has a wonderful view of his culture. He knows that when one facet of it disappears, the rest will soon go. Without deer they cannot hold their annual feast or the rain dance. This brought on the five-year drought, Pisakana told us. They cannot "feed their dead" properly or make offerings to the Great

continued on page 224



▲ WITHIN A FEW DAYS after the normally transparent covering of the eyes becomes clouded, the outer epidermal layer of the skin breaks at the end of the snout. The work of turning the skin inside out is then begun. The snake can see again as soon as it has peeled back beyond the eyes.

HOG-NOSED SNAKE *gets new suit*

A harmless reptile sloughs off its outworn skin and displays a fresh garb, same color and pattern but a size larger

A Photo Series by JOHN GERARD

Text by CHARLES M. BOGERT

SNAKES become temporarily blind when they shed their skins, because the normally transparent covering that protects the eye becomes clouded a few days before the shedding process begins. For this reason, and because the creatures are apparently more susceptible to loss of water through evaporation at this stage, they rarely move about at shedding time.

They usually remain under logs, rocks, or in other secluded places till their vision is no longer obstructed by the opaque covering.

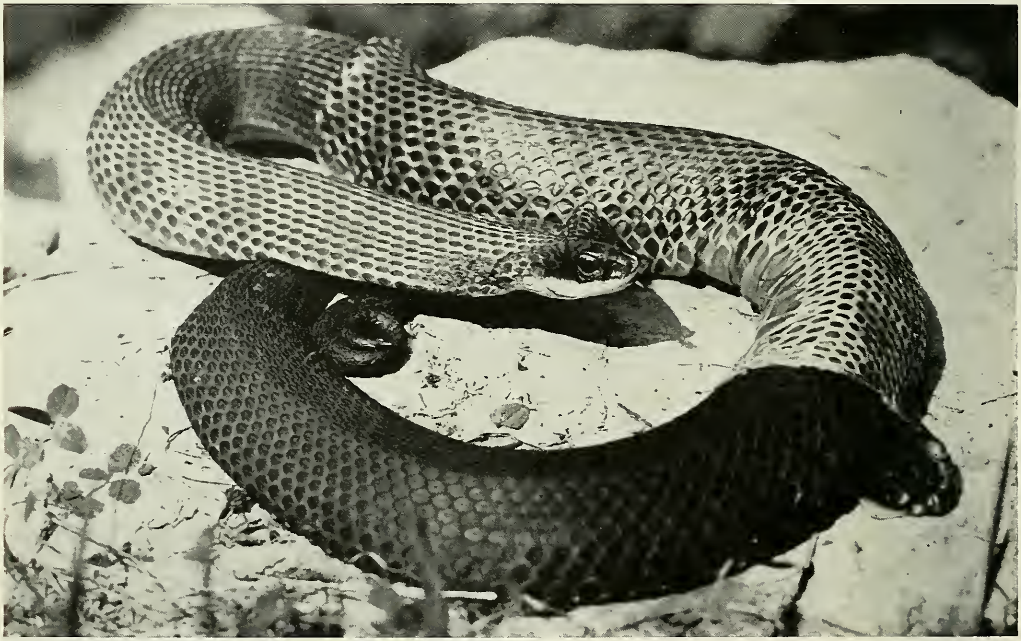
During this period of blindness, the snake can still detect the presence of prey by means of the tongue, which is part of a smelling mechanism. The forked tip of the tongue itself is not sensitive to odors, but it is instrumental in picking up odorous particles in the air and carrying them to the sensory Organs of Jacobson in the roof of the mouth. Whether blind or not, many snakes employ the tongue in this manner to locate prey or even to follow the scent of an animal.

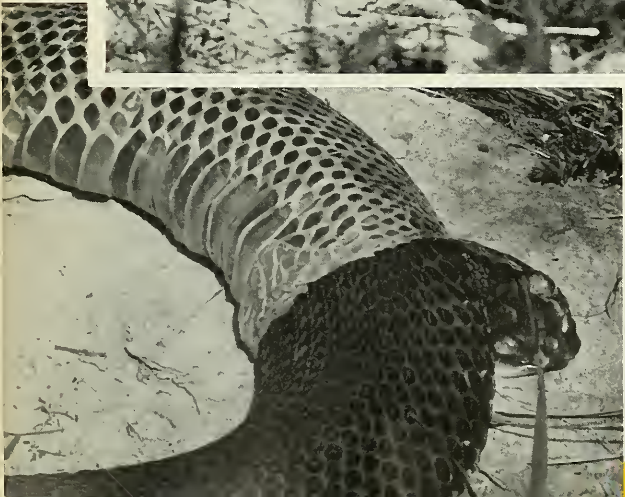
No one appears to have reported how often the hog-nosed snake, which is the species shown here, sheds its skin. But all snakes shed their skin shortly after emerging from the egg, and if this snake's habit resembles that of the rattlesnakes, it sheds more frequently while young than as an adult. The Pacific Rattler is known to shed from three to six times during its first year. After reaching adult size in about two and one-half to three years, the female sheds her skin only once a year, whereas the male sheds his about three times in two years.

Some kinds of snakes apparently shed their skins far more often than others. Furthermore, snakes living at higher elevations or in latitudes where the season of activity is limited by cold, quite possibly shed less frequently than those in warmer climates where the creatures can remain abroad for longer periods during the year.

Even though the skin is shed more often during the animal's growth, there is little to support the conclusion that it is initiated merely by a "tightening of the skin," as is often assumed. Some snakes continue to shed even when no growth can be observed. There is some evidence that an injury to the skin accelerates the process and that the shedding is partly under the control of hormones, as has been found to be the case among lizards, whose shedding has been studied more extensively.

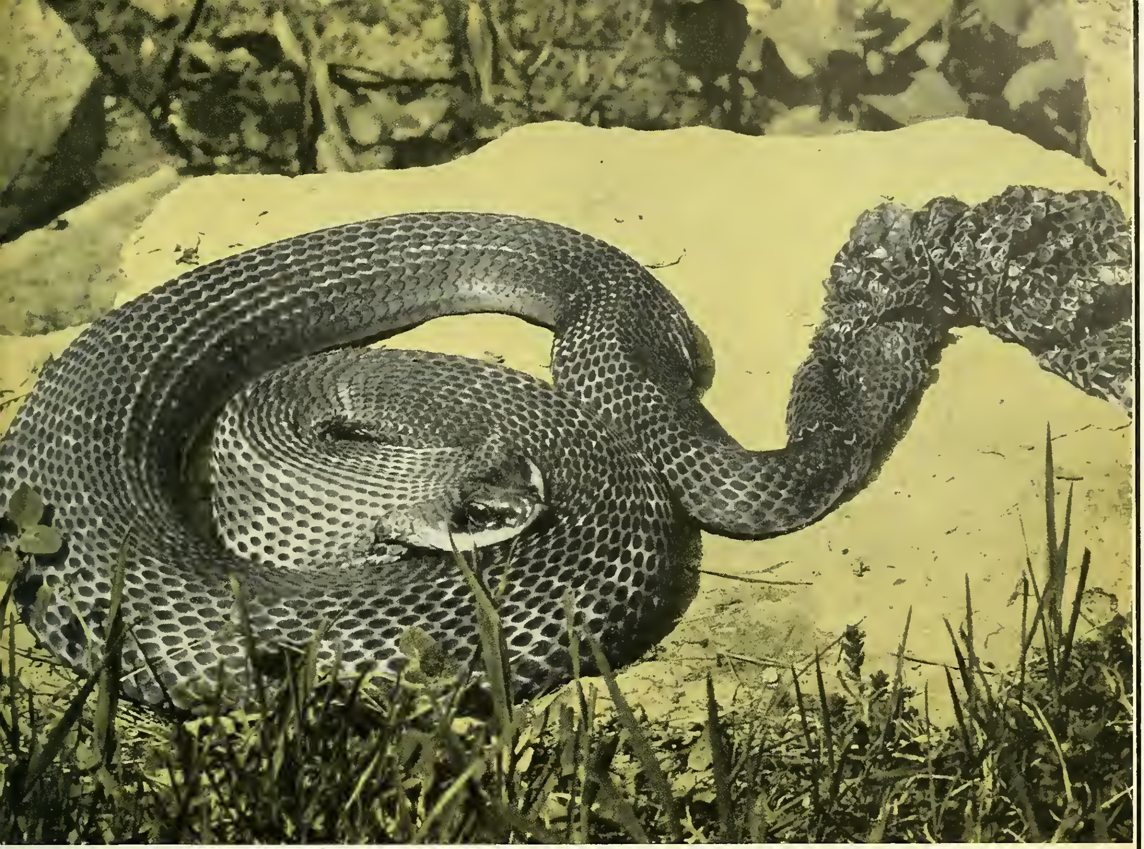
The shedding ordinarily begins at the snout and proceeds as shown in these excellent photographs.





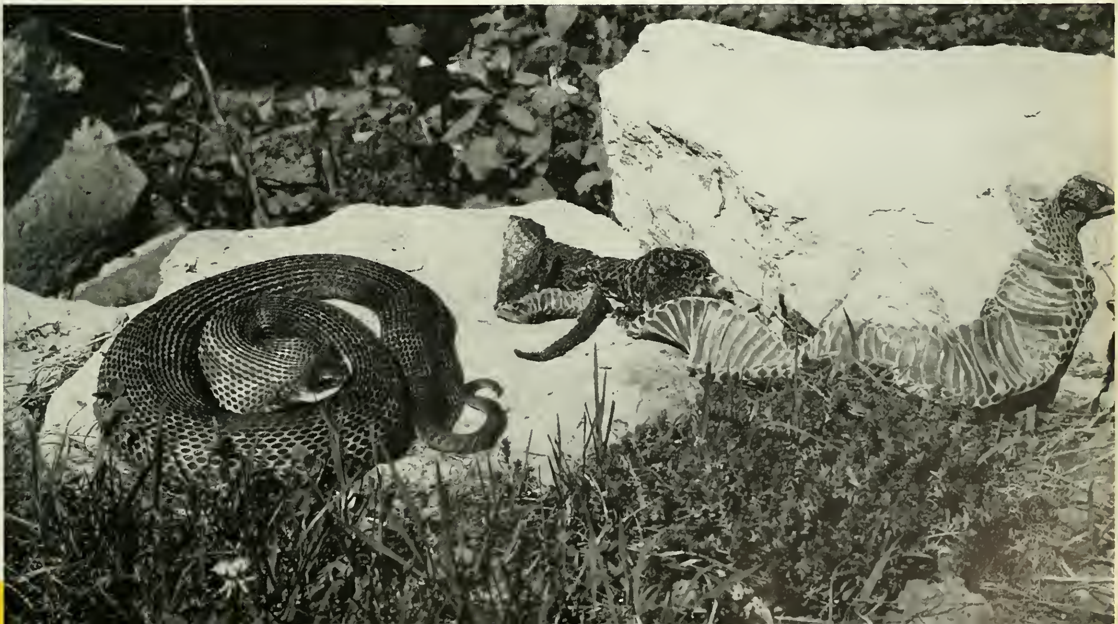
▲ In many snakes (but not all) the skin at the side, where the outer layer is coming loose, is shifted by means of the muscles. This facilitates the separation of the outer transparent layer.

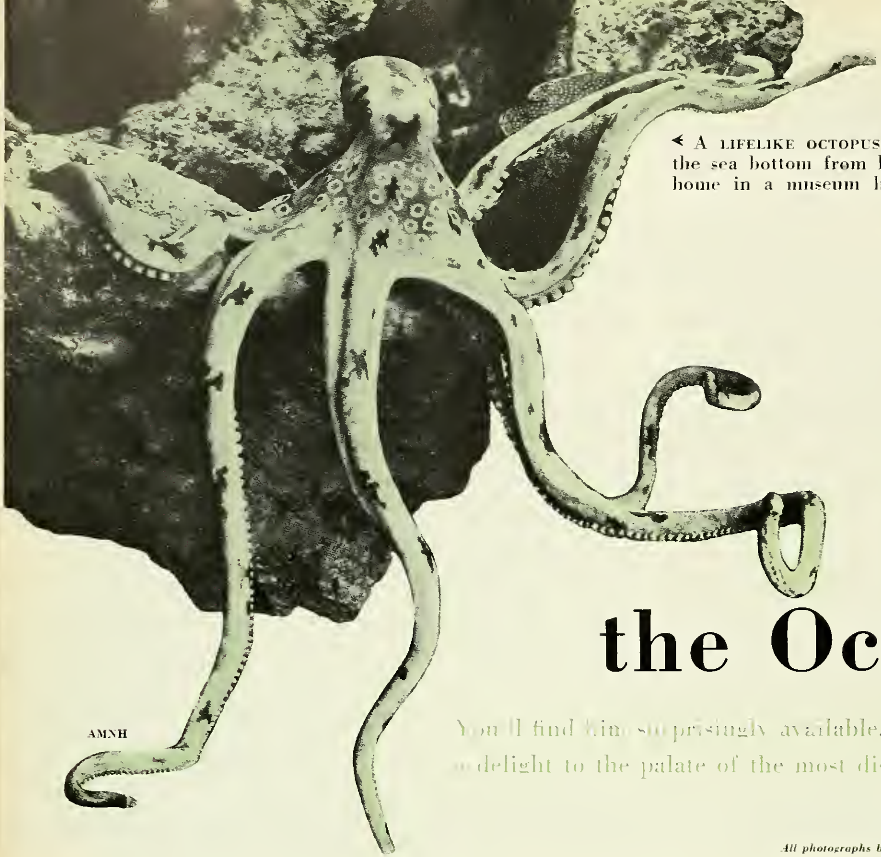
◀ The snake's body beneath the old skin is glistening and fresh. Immediately before shedding, the skin appears to be much less impervious to water and more subject to evaporation. This is probably why captive snakes often resort to coiling in their water containers.



▲ THE SNAKE rubs itself against rough objects in order to get rid of the skin, which comes off wrong side out like a pulled-off sock. The entire process takes but a few minutes.

▼ PEOPLE ARE sometimes startled by the cast-off skin, which is a ghost-like reminder of its former occupant. It has no commercial use, but there is at least one bird (the crested flycatcher) which insists upon a cast-off snake skin to line its nest.





◄ A LIFELIKE OCTOPUS descends to the sea bottom from his coral-reef home in a museum habitat-group.

AMNH

Meet and Eat the Octopus

You'll find him surprisingly available, easy to capture, and a delight to the palate of the most discriminating gourmet

By GARY DAETZ

All photographs by H. Van Daetz unless otherwise credited

TAKE nourishing salt water foaming against a gravelly beach studded with boulders. Choose a spot sheltered from vigorous wave action. And no matter what the latitude, you have octopus habitat. For this legendary, unusual animal inhabits every ocean of the world.

No creature could be called more spineless than the octopus—he hasn't a bone in his body—yet he has the respect of sea creatures equipped with heavy armor and of cold-blooded animals with backbones.

He is a shellfish without the shell, but he has evolved into a nimble predator of which his molluscan progenitors could be proud. Among the standard equipment found on every octopus today are such features as powerful suction cups on eight arms, built-in jet propulsion, well-developed eyes that open and close, an ever-ready smoke screen, and semi-automatic color change—faster and more striking than that of any other animal.

Along the coasts of the United States, the octopus population is near the saturation point, because he is rarely hunted for food here. But the early Greeks and Romans thought him a credit to a well-balanced meal; indeed, he was ranked with the finest foods of the sea and was hunted vigorously. In the Orient, he is considered a delicacy and is both trapped and speared. In the Mediterranean, the Philippines, Japan, and Alaska he is taken for food in considerable abundance. Strangers to the octopus often feel that he would not add beauty to the festive table, but actually he is not much worse looking than a crab or a lobster, and need not be served entire. The meat itself is firm, pure white, and of a mild delicate flavor.

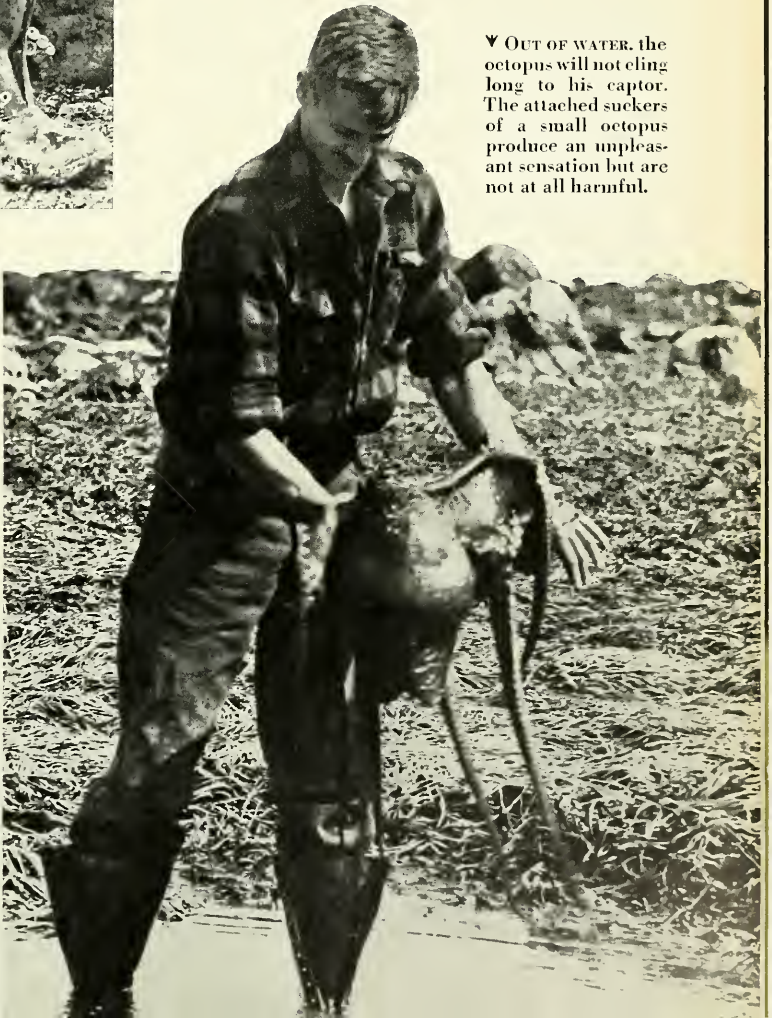
Even if young Americans should go wild over the new taste thrill, there is little danger of exterminating the octopus. Octopuses have been found scattered from the surface and tidelands to a depth of 1,875 fathoms (*benthoctopus*), and one authority includes 140 species in the suborder Octopoda. Most are coastal in habit. Even the largest octopus, which has been measured at 28 feet in diameter, prefers water shallower than 50 fathoms.

Our own interest in octopuses began in Alaska. We had grown tired of a diet of duck, puffin, clam, and bear meat, and when we hunted the beaches of our remote island, the best thing we found was octopus—and right at our doorstep. Once we knew how to look, our little bay seemed to offer enough octopuses to supply us with meat at every tide that was low enough. The giveaway sign was an entrance hole under a boulder with a gravel and shell delta for a

▲ Unable to endure the copper sulfate introduced into his lair, the octopus crawls out. No matter what obstacles stand in his way, he always tries to crawl downslope— toward the sea and safety.

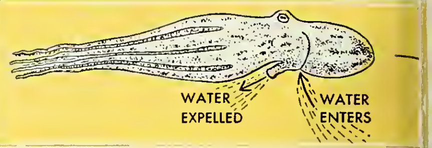
◀ The octopus's boulder home is surrounded by dry land at low tide, making him easy to capture, once you find him. When picked up, he reaches desperately for something solid to which to cling, and if a tentacle finds his captor's boot, all suckers will turn toward it.

▼ Out of water, the octopus will not cling long to his captor. The attached suckers of a small octopus produce an unpleasant sensation but are not at all harmful.



doorstep. We carried our hunting technique to Puget Sound and found that no one there but the local Indians realized that octopuses were close at hand.

It's good outdoor fun to prowl the beaches during the half to three-quarters of an hour the tide allows, trying to capture an octopus for dinner. We discovered that even after we found one it took a lot of time to pry the boulder off his lair and wrestle him from his hold on the rock bottom. Then we learned a simpler method of getting him to come out and crawl for open water. You wrap a few ounces of copper sulfate in a cloth sack, and, after tying it to a supple stick, introduce it into the pool under the boulder. If the octopus is at home, he will soon do a lot of flushing, churning, and squirting of "ink." Then the arms will begin to pour out of the entrance. Once out, your 15-pound octopus can be picked up without



◄ THIS VIEW shows an eye and one opening in body cavity. It is into this opening in the f octopus that the male inserts his suckerles tacle for breeding. These openings are als portant in respiration and swimming. Wa drawn through them into the body cavity, ba the gills. When the cavity is fully distende valves are closed and the water is forcibly ex through a tube-like siphon—shooting the oc through the water by jet propulsion.

the slightest danger and put into a sack.

If you let him swim in salt water a bit to flush the copper sulfate out of his gills, he'll stay alive out of water for 24 hours in cool weather. I found this out when I had to search my tool shed for an octopus I thought I had killed and left in a pail. I found him the next day, alive, behind a box in a corner.

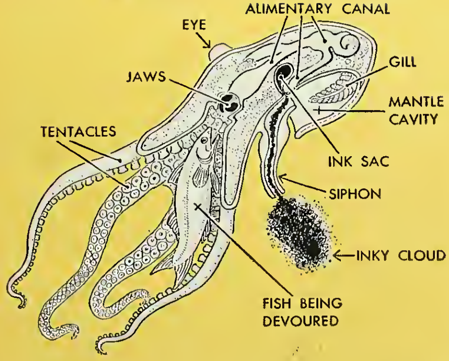
Watching an octopus change his color is an experience in itself—especially if he's in a hurry to do it. The dead gray-white color of a relaxed octopus changes to a brilliant red-brown as waves of color flash and fade through his skin. The changing colors—like the beginnings of an aurora borealis—result from contraction and expansion of pigment cells called chromatophores in the topmost layer of the skin. Light-reflecting cells called iridocysts give the skin an iridescent shimmer. The octopus is a beautiful animal in its own peculiar way.

Either slithering toward the sea when evicted from his lair at low tide or swirling through the water, the octopus has a look of competent self-sufficiency about him. People have imagined that he radiates evil intentions through the narrowed slits of his eyes as he squints against the bright sunlight, which he tries to avoid. But we cannot assume he has a grudge against the human race. He simply looks out for his own interests like the other animals of the sea. On land, he doesn't even hold on very long before he folds his suckers and writhingly tries to escape. And it seems unreasonable to condemn mother octopuses who have been known to seize divers threatening to disturb their eggs.

A reluctant villain

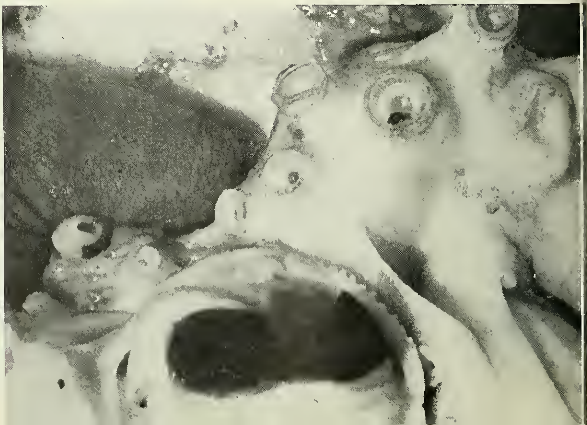
So far as I have been able to find, there are no recorded deaths due to attacks by octopuses. Nevertheless, every undersea movie has someone battling the tired old fellow with eight arms. The octopus always gets the worst of it, and it's a hard life. He would be much happier if left peacefully in his

Drawings by
Dr. George H. Childs



A cross-section shows internal features. The mantle cavity is the structure that gives the octopus its pulsating, balloon-like "head." The inky cloud is discharged in time of danger.

▼ A HORNY BEAK-LIKE STRUCTURE contains the octopus's jaws. are located in the center of the eight radiating arms and ar rounded by a thick layer of muscle which gives them a pow bite. They are not used in combat, since they are proportion quite small, and are poorly located for such a purpose.



rock crevice. But if he should lose an arm fighting off a shark that the movie director has put into his tank, he can regenerate it in time for the next thriller and unwillingly go through it all again.

The octopus is sensitive and downright fussy about the company he keeps. He likes crabs and clams —his favorite food—but is quite repelled by the sluggish starfish. If a starfish should amble into his home while he is out, the octopus refuses to enter. And if a starfish comes to the entrance while he is there, he refuses to come out. He reacts intensely to holothurians (sea cucumbers). Certain natives have made use of this aversion. If a sea cucumber is dropped into his lair, the octopus swirls out in a hurry and can be speared.

One reason why octopuses have survived and thrived through the ages is that they take even better care of their eggs than some animals higher in the evolutionary scale. From 10 to 100 eggs are attached in clusters by stemlike stalks to the rock wall in the lair. The mother broods over them, syringing them with jets of water from her syphon. Her respiration becomes rapid and shallow, rising from a normal of 6 up to 30 respirations a minute.

Baby octopuses, waving their tiny tentacles and staring wide-eyed at the frightening world, even have something of the same helpless appeal that other newborns convey.

The male octopus is easily recognized because the end portion of one arm has no acetabula, or suckers, on it. The tip of this arm becomes charged with spermatophore capsules, which are injected into the female. In some octopuses, the tip itself detaches and remains in the mantle of the female.

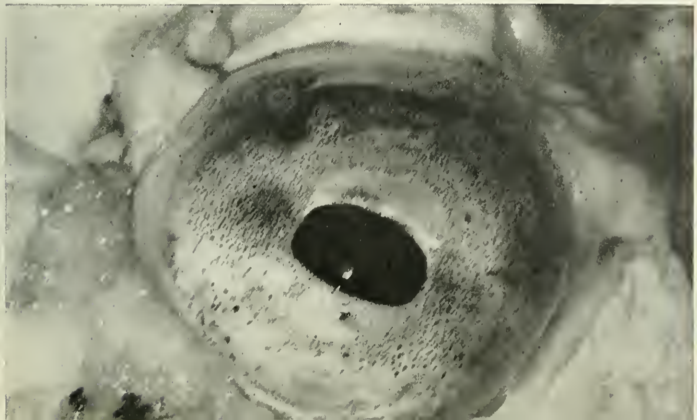
The octopus has a problem that even the most highly developed animals could appreciate—difficulty in finding adequate housing. His needs are simple: any good cavity will do, but if the bottom does not provide enough crevices, he will dig his own. The tendency to enter any ready-made cavity has proved the downfall of many an octopus in the Mediterranean, for the fishermen there take advantage of his eagerness. They lower an earthenware crock to the bottom with a floating marker attached. The octopus is easily lured into this elegant, smooth-sided prefab with everything but the "vacancy" sign on it. He gathers his arms together and moves in, there to pass the daylight hours after a hard night of crab hunting. Even when he feels the fishermen hauling him up, he doesn't come out until it's too late.

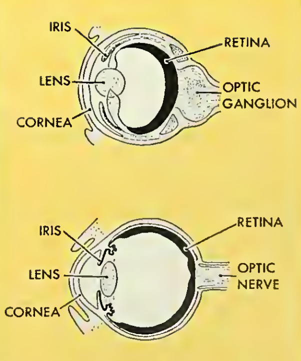
The same principle is used on Puget Sound by the only commercial octopus fisherman there. He uses a series of open-ended boxes attached to a heavy line at 30-foot intervals. The line is marked by a buoy at either end and is lifted at three-day intervals. The octopuses I saw taken commercially on the Sound had a spread of up to 6 feet and weighed as much as 50 pounds. The fisherman's only difficulty here, as elsewhere, was in evicting stubborn tenants. He used a bit of lye instead of copper sulfate.

When the tide falls, the octopus will lie low under his boulder, surrounded by dry land, rather than lose his home to a starfish or sea cucumber. And though his appearance will suggest that he has been dead there for days (he remains inert and is a gray-white color), he may well be nervously "twirling his thumbs" until the tide rolls in. For only then will he be safe from his enemies of the air-world.

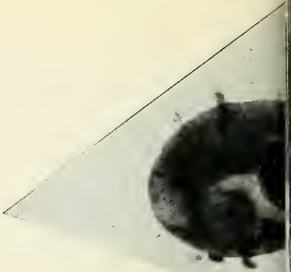
In the salt water, he can meet those who might challenge his authority at considerably less of a disadvantage.

▾ THE EYES of the cephalopods, the class to which the octopus belongs, are more highly developed than those of any other group of invertebrates, and are remarkably similar to human eyes. In the photograph below, the fine dots around the pupil are chromatophore clusters. They expand rapidly in association with the octopus's striking color change.





Which eye is the octopus's? An artist's look-alike drawing shows a striking similarity. It's the top one; the bottom eye is human.



Warfare in the Micro-World

In the realm of the microscope, a host of fierce little warriors fight one another with ingenious weapons which pre-date all that man has devised

By Eric V. Grave

All photographs by the author unless otherwise credited

We humans are too much impressed with our own resourcefulness. It is true that our ancestors probably could not have survived in the world of fang and claw without well-developed brains for devising substitute weapons, but we often overlook the fact that their spears, knives, and poison arrows were preceded by similar devices used by other creatures since the dawn of life.

A microscope helps to deflate the ego, since many of the more ingenious of these weapons are too small to be seen with the naked eye. Some of them would greatly tax man's inventiveness if he were to try to copy them even today.

For instance, the deceptively sluggish Hydra—which takes hours to change its position only a few inches—kills with lazy efficiency by lashing out at its victims with poisonous whiplike threads.

It remains almost stationary on a rock or other hard surface, with tentacles spread, moving them spasmodically now and then. The tentacles are studded with bodies called nettling capsules, comparable to tiny guns. Each of these contains a poison and a hollow, barbed thread coiled like a hairspring. When a potential victim, perhaps a water flea, brushes against Hydra's tentacles, some of the capsules explode and eject their threads. These strike the prey and paralyze it with poison exuding from their tips. Hydra is then ready for a leisurely meal.

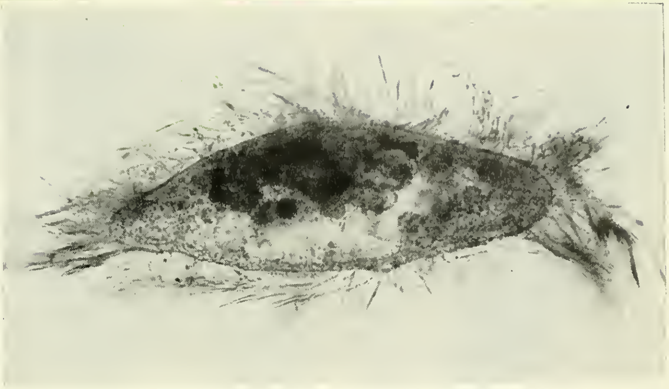
Hydra's guns are more efficient than man's. They will not fire accidentally, but only when organisms suitable for food touch the tentacles. Amazingly enough, they will not discharge when touched with a leaf or a stone, or even when irritated by a parasitic polyp-louse crawling along their surfaces. After use, nature provides Hydra with new guns in only a few hours.

There is an even smaller warrior, a one-celled animal called *Didinium nasutum*, which overcomes its neighbors in a manner having almost no parallel among higher animals. Didinium feeds mainly on the paramecium, or slipper animalcule, which is faster and larger. Both are blind, so it is pure chance that they bump into each other. But, when they do, Didinium clamps its snout tight against paramecium and, snake-like, simply widens its mouth little by little and engulfs its victim whole. Ultimately, it swells to two or three times original size.

Paramecium has almost no defense against Didinium, but it does have a battery of curious mechanisms that have been labeled defensive by some observers. These are the trichocysts, a multitude of tiny oblong sacs, each of which, in the resting stage, is only 4/1000ths of a millimeter long. When paramecium is attacked, these shoot out in all directions to screen the animal with a forest of outthrust threads. Just how they stretch out so quickly is not understood.

The larvae of certain European moths have microscopic weapons capable of inflicting injury even upon man. These are the processionary caterpillars, so named because of their habit of moving about at night in meandering caterpillar-armies up to six feet long. This habit makes them extremely vulnerable to birds, so the poisonous hairs that they have evolved should be classed as defensive weapons. They are so brittle that they are sometimes broken off and carried by the wind into the eyes and mouths of unsuspecting hikers, causing acute inflammation. Forests

< **A trio of Didinia,** viewed at 300 times magnification. These pond-dwelling protozoa swallow their neighbors whole.



^ **Paramecium's** thread-like trichocysts suddenly take form as a protective screen, but do not faze Didinium.

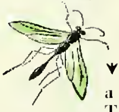
< **The poisonous hair** of a European processionary caterpillar (*Thaumetopoea pityocampa* Schiff). These brittle spines sometimes are carried by the wind into the eyes and mouths of unsuspecting woodsmen, causing painful inflammation.

From a slide by Louis-Jacques Laporte, Paris, France

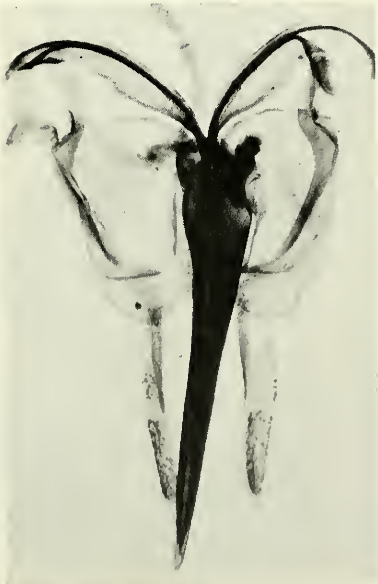
in some parts of Europe have been closed to the public when dangerously infested.

Much of the fighting in the micro-world is chemical warfare, the daggers and spears being devices for injecting poisons. Superior users of this technique are some of the solitary wasps. They have refined it for the purpose of furnishing "strictly fresh" food for their larvae offspring. Their poison is such that the weevils, caterpillars, or flies into which they inject it are not killed but indefinitely anesthetized, waiting to become banquets for future wasp families.

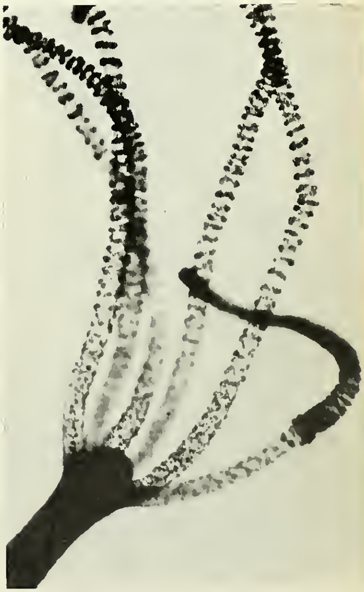
A dramatic instance of this natural anesthesia is the performance of the wasp *Cerceris tuberculata* Klg, which chases exclusively a luckless weevil called *Cleonus opthalmicus.* When Cerceris locates Cleonus, she grabs him and during a brief struggle plunges her stinger into a nerve center in his chest. Cleonus drops thunderstruck; the wasp lifts him and carries him off to her nest. She repeats such conquests until, several weevils later, she is ready to deposit her eggs and seal the nest, never again to fret about fresh food for her brood.

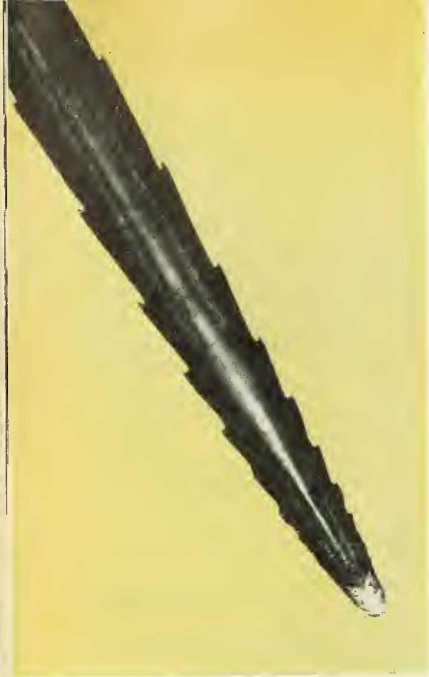


v **The stinging apparatus** of a wasp, detached from the body. Two different chemicals are injected simultaneously to paralyze the prey.

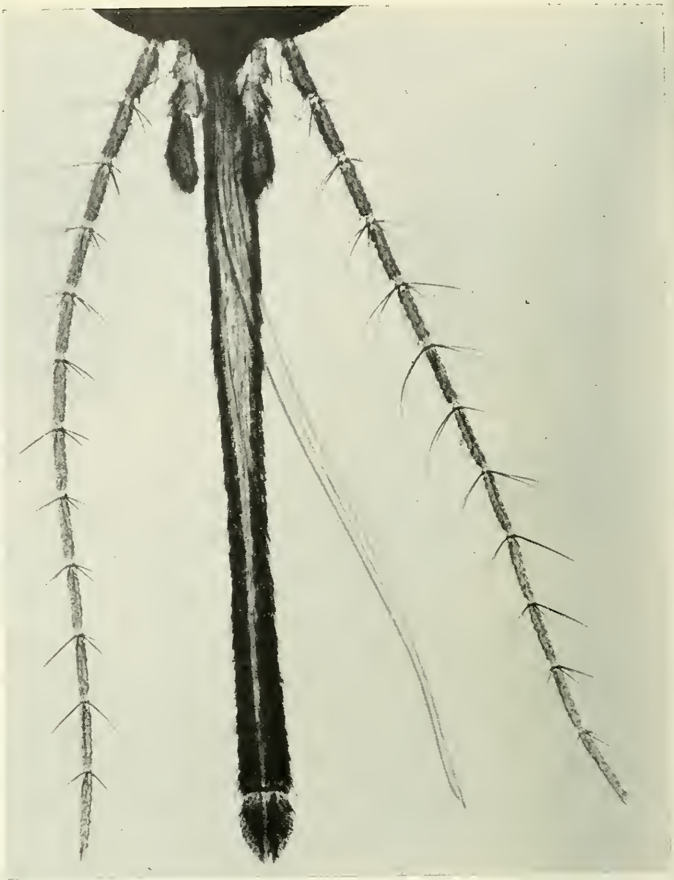


v **Hydra** (named after the nine-headed monster slain by Hercules) waits for a victim to brush against its tentacles, then paralyzes it with poisonous threads shot from nettling capsules.

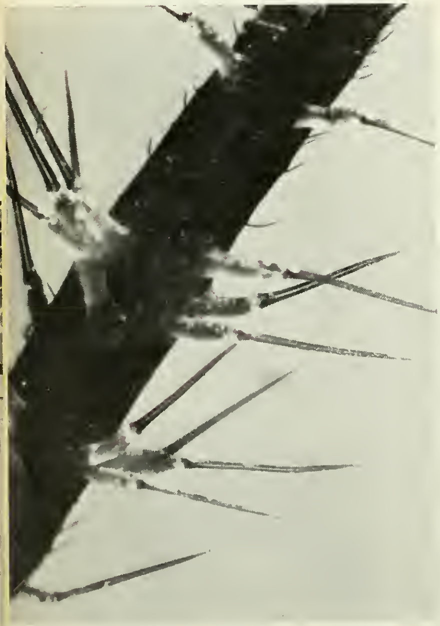


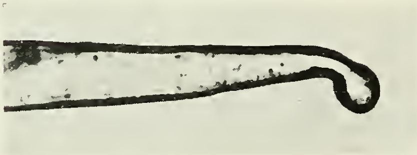


▲ BARBS ON THE STINGER of a worker bee hamper its removal after use, so that the bee usually dies as the stinger is wrenched from its body.



▲ PROBOSCIS of a female mosquito. The sucking tube is here separated from the heavier sheath. The male is unarmed and subsists on plant juices instead of blood.





◄ MINIATURE SYRINGES of the stinging nettle are sealed by tiny knobs at their tips (enlarged view above). In action, the knobs break off; the needles pierce the skin, and poison from their bulb-like bases squirts into the wounds.

Another wasp, *Eumenes pomiformis* Fbr., catches caterpillars for her offspring, but apparently is unable to paralyze them completely, for, after anesthesis, they still move when touched. Eumenes makes up for this imperfection by suspending her eggs from threads attached to the ceiling of the nest. When the larvae hatch and begin to feed, they can escape injury when the caterpillar begins to struggle by climbing up the threads.

The venom that accompanies a wasp's sting is a mixture of two chemicals produced in separate glands. One gland secretes acid into a large poison sac; the other secretes an alkaline fluid into the base of the sting. The fluids are mixed when the wasp uses her sting, and the mixture is more effective than either would be alone. Two fingerlike sense organs enable the wasp to pick the best spot for injection; strong muscles pump in the poison, and two more glands are believed to lubricate the various parts involved. All in all, a very complex machine.

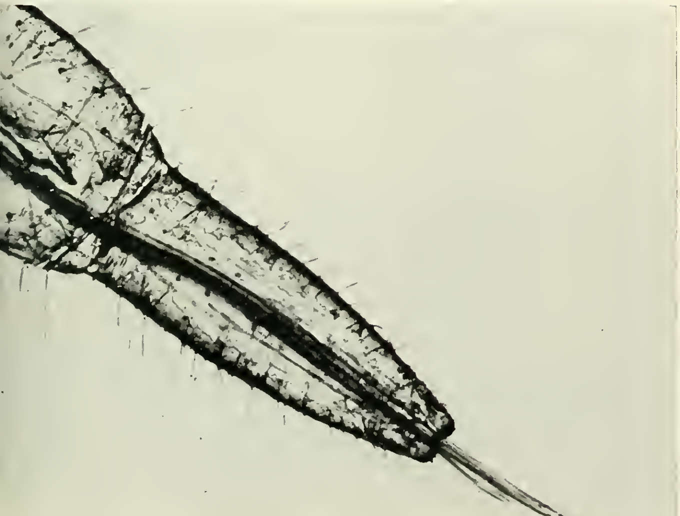
A worker bee's stinging apparatus is much the same except that it is ordinarily used only once, while the wasp's may be used many times. The bee's sting is barbed, and she has great difficulty extracting it after she has thrust it into an intruder. So she usually suffers fatal injuries—a miniature kamikaze. The reason she almost always dies is that her complete stinging apparatus, with poison sac attached, is usually wrenched from her body and left sticking in the wound. The detached muscles keep on working and drive the sting in deeper and deeper while more and more poison is pumped into the tissues.

Thus the bee is sacrificed, but she does a better job than she could have by simply puncturing the skin and rapidly flying away.

It is impossible when studying these tiny weapons to keep from comparing them with familiar instruments in the doctor's office, and the similarity is almost uncanny in the case of the stinging nettle—a troublesome plant.

The stinging nettle is equipped with many thousands of stiff hairs constructed like tiny syringes. A vesicle at the base of each hair contains a poisonous fluid, mainly formic acid, and the hair itself is actually a long, hollow, very brittle needle, closed at the point by a tiny knob. At the slightest touch the knob breaks off, the hair penetrates the skin, and the resultant pressure against its base forces toxic fluid into the wound. It is a fine weapon against herbivorous animals, but not good enough to withstand occasional attacks by "Old Country" housewives who — armed with knowledge and gloves — harvest nettles to make spinach when other food is scarce.

▼ THE BEDBUG'S proboscis has tiny stylets inside it which pierce the skin and allow the blood to flow.



But the micro-weapons with which we humans are most acutely familiar are the tubelike mouthparts of blood-sucking parasites, such as mosquitoes, bedbugs, fleas, and lice. For these diminutive creatures have the audacity to choose *us* as their victims. Fortunately, we still have the upper hand.

One of their weaknesses is that while thrusting their needles, stylets or mandibles into our skin, they must simultaneously inject saliva into the wound to keep the blood from clotting. This creates a momentary irritation which warns us that we are being attacked, and spurs us to counter-attack.

To a bedbug this is a serious problem, because he needs five to ten minutes to get a satisfying meal. Furthermore, he needs at least one hearty meal between each molting in order to develop into a healthy, robust adult. It's a dangerous life.

If you are inclined to imaginative thinking, a few hours of peering through a microscope at the fierce little world of the bedbug and his confrères will make you eternally grateful to Providence for giving us an advantage in size as well as an advantage in intellect over these diminutive assassins. For, with their knives, stilettos, needles, tentacles, poisons, and anesthetics, they might have carved quite a different niche in the scheme of life if nature had made them larger.

CONSIDER THE COCONUT

continued from page 180

on a stainless steel belt as a fluffy white stream.

Thus shredded, the coconut meat now passes through immense dryers, or ovens, 75 feet long and 10 feet wide. After drying, it is slowly cooled and made ready for the sieves. These are vibrating wire screens of varying mesh by which the meat is graded into uniform lengths of "thread," "shred," and "macaroon." Each type is packed in 100-pound, multi-ply paper bags closed with tape and stitched on sewing machines. The bags are now ready for their long steamship journeys to the United States and other coconut-consuming countries.

Because of the delicious flavor of coconut as we know it in baked goods and confections, we naturally think of shredded coconut first among the various products of the tree. But we should be equally aware of copra, since it is the product mentioned in many romantic stories of the South Seas. Whereas the process of shredding coconut is almost entirely confined to the Philippines and in a smaller way to Ceylon, the production of copra is dispersed throughout thousands of tropic islands and mainland beaches washed by the Pacific and Indian Oceans and our own Caribbean Sea. But the operation of the plantations is much the same everywhere, except that the copra stations are so widespread that numerous methods of drying have been developed by individual planters.

Where there is a long dry-season, copra is sun-dried. The shells are merely cut in half so that the meat can be exposed. As drying proceeds, the kernel shrinks away from the shell. The separated meat may be spread on coarse palm leaf mats or on wooden trays for further exposure. But where sun-drying is impossible, artificial dryers are employed. These vary from crude rectangular pits fueled with burning husks and shells to highly efficient ovens heated by steam or hot air.

Early European explorers were greatly impressed with the versatility of coconut oil, noting that it could be used for food, illumination, and cosmetics. But it was not until 1750 that a French sea captain actually brought coconut oil from the South Pacific to Europe. He carried a cargo of copra to Marseilles and sold it to a local oil mill for use with other oils in the manufacture of soap. Thirty-five years later, Louis XVI offered a reward for an inexpensive butter with good keeping qualities, pleasing flavor, and high food value that could be prepared in large quantities and offered to the common people. A vegetable margarine was the result, prepared by blending refined coconut and peanut oils.

During the following two and a half centuries, coconut oil continued to find its place in the world's economy, and today some two million tons of copra are required each year to supply the demand.

The early mills were extremely crude, being nothing more than hollow logs, or troughs, filled with copra and equipped with long timber levers that were forced down upon the contents to expel the oil. Another form was a trough into which was placed a copra-filled goatskin bag. Wedges were driven between the bag and the sides of the trough, developing sufficient pressure to force the oil through the skin. Other contrivances were simply mortars and pestles, in which hand-pounding released some oil. Naturally these crude efforts extracted but a small proportion. They are a far cry from the modern oil crushers that extract 65 per cent of the weight in oil and leave a dry meal for cattle food.

When nature imbedded the coconut in its highly efficient husk, it also gave mankind a fiber known as *coir* (rhymes with foyer), which has proved a boon to generations.

Coir rope is particularly valuable where elasticity is desired. The fiber will stretch fully 25 per cent, and tests have shown that it is stronger than any other commercial fiber in general use that has to remain for long periods in salt water. Its one drawback is brittleness when dry.

Although there is a ready market for coir, the best grades must come from coconuts not fully mature, and as a result the great majority of husks must be burned for fuel.

But let us not blame the coconut for not giving us the best of everything all at one time. No other plant has served man better. From intoxicating *arrack* to captivating cakes and candies, from hardy fiber rugs and cordage to healthful vegetable margarine, this single tropical plant has joined within its stately figure such an amazing combination of qualities that it fully deserves to be called the Delight of Royalty and Provider of the People.

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Department M

continued from page 174

largely inadequate, is based on complete frankness. He is willing to admit that some problems are still unsolved. Yet he makes the best of available theories, and reaches conclusions that are reasonable and direct.

Anyone who wishes to augment his knowledge on the subject of meteorology, and enjoy the effort involved, should read this book. It will be especially valuable to students who are seeking a rounded, interrelated supplement to more formal reading in the subject.

JOSEPH M. CHAMBERLAIN

WORLD OUTSIDE MY DOOR

- - - - - - - - by Olive Bown Goin

The Macmillan Company, $3.50, 184 pp.

THE world outside Olive Bown Goin's home is the subject of this delightful diary-like account of the animal life she makes a point to see every day. A naturalist in her own right, wife of a college biology professor, and mother of two children, Mrs. Goin added to her daily homemaking tasks the job of recording a day-by-day list of the animals and their activities in her own yard.

The Goin's yard is just south of Gainesville, off a busy highway in north central Florida, on a roughly rectangular lot about 200 feet wide by 75 feet deep. Despite its size and location, it is amazing to find that in five years, Mrs. Goin saw 72 different kinds of vertebrates, including 18 amphibians, 22 reptiles, 24 birds, and 8 mammals. Not all of these are present at the same time: some are summer guests; others are winter, spring, or fall residents. But Mrs. Goin is not merely listing the kinds of animals she saw; she is also making notes on what their activities are. In this way she is gathering information on their breeding activities, their food habits, and their movements in and out of her yard.

The simple caricature line drawings add humor to the very readable text. The list of common and technical names in the appendix will be useful to those with a serious interest in the vertebrate fauna of Florida. The casual reader will find a well-written account of backyard natural history.

B. M. HECHT

STREAMS, LAKES, PONDS

- - - - - - - by Robert E. Coker

The University of North Carolina Press
$6.00, 327 pp., 25 photos, 28 drawings

Streams, Lakes and Ponds should open our eyes to the freshwater world. This book is packed with enough information about our inland waters and their aquatic animals and plants to be a guide to freshwater life. Yet the book is more than a guide, for it considers our urgent need for a conservation program to perpetuate our freshwater resources, now rapidly being depleted.

Coker reveals the inestimable value of our inland waters over and above our primary needs for drinking, cooking, and washing. River and lake waters have served us as highways for travel and transportation, and still do to a degree unappreciated in our present age of concrete roads. The industrial uses of water

"Naturally, I changed my taxidermist."

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are enormous. The amount used has increased fourfold in the past 15 years in the production of coal, oil, steel, and a thousand other every-day, vitally-needed products.

Ought we to drain our marshes and swamps for agricultural or industrial purposes? Coker points out the dangers of indiscriminate elimination of these water areas. Many communities have found, too late, that the lowering of water tables and the reduction of their water reserves follow in the wake of drainage. These add up to troubles, sometimes disastrous. The recreational uses of inland waters are being appreciated more and more by those who find the cost of waterfront property constantly rising.

No book on freshwater would be complete without a section on fishes, fish ponds, and fish culture. Coker's advice on these matters is practical and sound in principle. He is up to date in the thought that most ponds suffer more from underfishing than from overfishing. Coker's approach to his subject is clear and scientific, but not necessarily popular. The reader will be pleased with his index to subject matter and with his valuable references to other books and papers in scientific journals.

MYRON GORDON

INTRODUCING SEA SHELLS

- - - - - - - - by R. Tucker Abbott

D. Van Nostrand, $2.50, 64 pp., 33 illus.

Introducing Sea Shells is an interesting and informative book for readers of all ages. The author has ably presented the many alluring aspects of shell collecting, and in his treatment of the subject has included many interesting facts about mollusks in general.

The reader is told how and where to collect shells, how to devise simple collecting equipment, how to prepare shells, and finally how to set up a collection of his own. There is a brief treatment of the major groups of mollusks to familiarize the reader with the wide variety of forms to be encountered in the mollusk world. Of interest, too, are the informative sections on shells, both rare and common, and on the curious ways of life among the mollusks.

The illustrations and color plates are excellent, the latter being reproduced from Abbott's fine book *American Seashells*. Several of the illustrations show sequences in the life cycles of certain mollusks or curious types of behavior in others. All of these are very informative.

In the back of *Introducing Sea Shells* are several useful lists for the beginning shell enthusiast. Here are listed shell names, dealers, and clubs. Also, there is a brief list of other books on seashells. This is an excellent book for children since its presentation is simple and inter-

The Screen

Authoritative comments on films in the field of nature, geography, and exploration

Edited by ELIZABETH DOWNES

▲ THE PROPS in the "White Feather" camp scene are excellent.

▼ THE INDIANS are appropriately dignified and dressed as Indians should be.

White Feather

Reviewed by HARRY TSCHOPIK, JR.
Assistant Curator of Ethnology

Stars: Jeffrey Hunter, Robert Wagner, and Debra Paget

"WHITE FEATHER," which deals with the opening of Cheyenne territory to white exploitation and settlement during the 1870's, might well have been just another inept and improbable tale of conflict between Indians and the United States Cavalry. It has been saved from falling into this category, however, by intelligent direction, sensitive treatment, competent acting, and exceptional photography. The seemingly inevitable battle between the cavalry and Indians — an ever-present threat from the opening scene—never materializes, and this unexpected restraint creates a feeling of tension that is truly surprising.

The film is not true history, although it often carries the conviction and impact of history. Similarly, few people will be deluded into believing that several of the principal characters are really Indians because, no matter how skillful the make-up, white people simply cannot be made to look like Indians. Yet, the Indians in this story are believable, because they are so far removed from the stereotype we have learned to expect. Unlike most painted, screaming red men of the screen, these Cheyenne have dignity, humor, arrogance, and humility. In other words, they behave like people.

Much of the illusion of reality achieved in *White Feather* is due to the costuming and set direction. So much attention has been paid to accuracy of detail that some scenes have an almost documentary quality. In view of so radical a departure from the standard product, it would seem unfair to point to the few inaccuracies that could be noted.

Throughout the film the photography is splendid, and the big scenes—including the Cheyenne camp, the Crow and Blackfoot tribes on the march, and the threatened battle that never comes off—are memorable indeed.

20th Century-Fox Film Corp.
CinemaScope and Technicolor
Running Time: 94 mins.

esting. There is no overburdening of the text with scientific technicalities, which are often deadly obstacles to the beginner. This book is especially recommended for the young shell enthusiast, though its appeal to adults as yet unfamiliar with shells will probably be equally great.

WM. D. CLARKE

BIRDS OF THE WORLD

by Paul Barruel

Oxford Univ. Press, $12.50
204 pp., 219 illus.

THE author, who is also the artist, joins matchless illustrations with a sound, up-to-date discussion of birds' attributes.

The pictures comprise photographs, many of which were made at stroboscopic speeds: color protographs of the highest excellence; color plates reproduced from paintings; line-cuts from drawings, diagrams, and maps. Altogether, they total about 260 and, despite their beauty have been assembled not just as "pretty pictures" but for their pertinence to a biological text. The foremost wildlife photographers in many lands, among them Barlee, Dragesco, Gacond, Haller, Hosking, Rankin, Sapin-Jaloustre, Schwartz, Swanberg, and Yeates, have contributed their best.

Mr. Barruel's method in writing the book is refreshing and timely. He considers birds neither by natural groups nor geographic areas but on a basis of their range of behavior within the Class. His examples, therefore, are drawn from many families and regions. In five chapters, the longest of which runs to 75 quarto pages, he discusses, in the light of the latest observations and experiments, the daily activities of birds, their reproduction, migration, relative gregariousness, and population dynamics. Even the best informed naturalist will find items to stimulate and surprise, as well as many that merely remind, in this concentrated, precise, and rewarding text.

Miss Phyllis Barclay-Smith, no less competent as ornithologist than as linguist, has evidently done as apt a job in translating from the French as in her previous rendering from the German of *The Bird*, by Gertrud Hess. The translator is no doubt responsible for the fact that British common names are followed in square brackets by the American equivalent: thus "long-tailed duck [old-squaw]."

Part of the duty of a critic is that of Devil's Advocate, namely to note errors or misconceptions. In combing Barruel's 200 pages, the reviewer has had to content himself with two, both of a minor nature. The African honeyguide, according to authoritative reports, seeks for itself not *honey* but beeswax. The New Zealand kea certainly does not "regularly attack living sheep." Its reputation rests upon extraordinarily few offenses. "The evil that men do lives after them," also applies to birds.

R.C.M.

* * *

"Untamed"

Reviewed by GEORGE G. GOODWIN
Associate Curator of Mammalogy
American Museum of Natural History

Stars: Tyrone Power, Susan Hayward, and Richard Egan

IT WAS a far cry from fox hunting in rural Ireland to homesteading in the bush of South Africa—at least it was in 1847 when "Untamed" is dated. A party of Irish and other emigrants with a Boer escort on an 800-mile trek through unfriendly country are attacked by a horde of armed, drum beating Zulus in full battle array. The film gives an insight into the hardships and privations that the early settlers went through in establishing a Dutch Free State in South Africa, a country where diamonds and gold nuggets were once harvested on the surface of the ground by the Kaffir natives.

20th Century-Fox Film Corp.
CinemaScope
Running Time: 111 min.

"Cinerama Holiday"

"CINERAMA HOLIDAY" shows the splendor of the great out-of-doors in a truly remarkable way. We bring this film to the attention of our readers because of the Swiss Alp scenes and those of our own Southwest and New England.

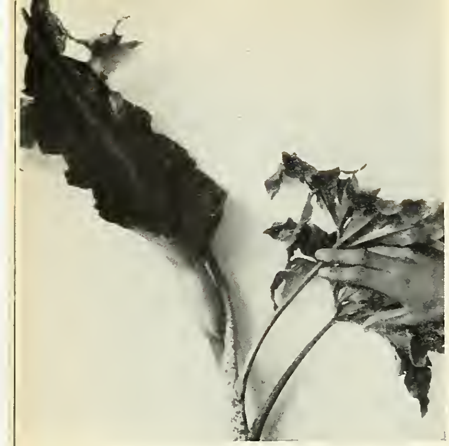
Dr. Gordon Ekholm of the American Museum's Department of Anthropology writes: "Seeing a Cinerama production for the first time was an extraordinarily impressive experience. From the first scenes, where one seems to be actually flying over the Swiss Alps and through the varied sequences of the picture showing places and people in Europe and the United States, one realizes that he is seeing the world by means of a new and remarkably effective medium."

Dr. Harold E. Anthony, Deputy Director of the American Museum, suggested that better subjects could have been chosen in some instances to employ the advantages of the curved screen. He writes: "The sound effects range from a pleasing sufficiency to an overpowering din. The most successful entertainment in the film is the great out-of-doors. On Cinerama, Nature can be truly grand."

Stanley Warner Cinerama Corp.
Technicolor
Running Time: 2 hrs. 17 min.

Films previously reviewed

Documentary and Grade A	**What the Experts Said**
Hunters of the Deep Undersea Life filmed in color	An excellent opportunity to become acquainted with the ocean's depths
The Purple Plain A vivid portrayal of man's struggle against the elements	A highly recommended film, shot in the Burmese jungle
20,000 Leagues Under the Sea Based on Jules Verne's book by the same name	Little natural history, but wonderful entertainment
The Vanishing Prairie A Disney film dealing with the vanishing wildlife of the American prairie	Exciting, instructive, and highly entertaining
Down the Alphabet	
Quest for the Lost City Adventures of the Lambs during their quest to discover a lost Maya city	Incredibly contrived piece of nonsense
Underwater "Underwater" is an adventure story built around a search for sunken treasure	Viewer sees little undersea life
Vera Cruz Filmed in Mexico. Story built around Maximilian's brief reign	Scenery good. Otherwise just a flamboyant "Western"



LETTERS

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ered that no less a person than Benjamin Franklin (whose interest in thermodynamics led him to design the Franklin stove) understood almost 100 years earlier than Petitot that the Eskimos used this principle. In his letter to the Dutch physician and scientist Jan Ingenhousz, published in John Bigelow's *Complete Works,* Franklin wrote: "It is said the Icelanders [he must have meant the Greenlanders] have very little fuel .... To receive more advantage from its heat, they make their doors low, and have a stage around the room above the door like a gallery .... The roof being tight, the warm air is confined by it and kept from rising higher and escaping; and the cold air ... cannot rise above the level of the top of the door, and so those in the gallery are not incommoded by it ...."

In Franklin's time, Poul Egede (1709-89), Otto Fabricius (1774-1822), and others were writing informative books on Greenland and conversing with men whom Franklin might have met or known through correspondence. It is likely that Franklin learned about the air-capture principle in this way.

Smellin' 'n Tellin'

Sirs:

It was with particular interest that I read your article in the February issue describing the "Big Stinker." Some time ago I was asked to photograph the large flower shown in this picture (*upper left*), which had a most horrible odor. It was with real fortitude that I managed to take the picture. Is this plant a relative of the Amorphophallus?

Ellsworth Hagen

Tracy, Calif.

Yes. Your nose knows—Ed.

Sirs:

Your interesting article on the flower that is the champion for size and smell reminds me that I have a runner-up growing in my backyard here in California. Readers situated properly in the climatic sense may be interested to know that it is possible to cultivate some of these monstrous pets, but I warn you that the one shown in the accompanying photographs also has stench as well as size.

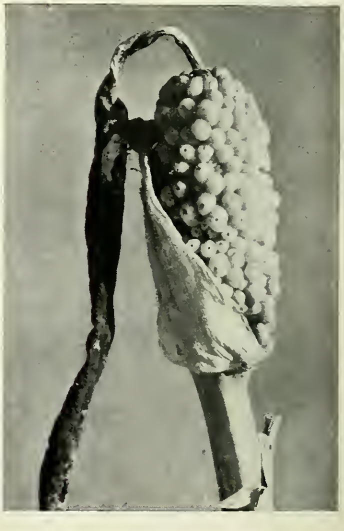
The plant is literally "the vulgar little dragon" (*Dracunculus vulgaris*). The lovely lady in the picture quite appropriately traces her lineage back to the far and fair land of Cathay where dragons are more or less at home in the lore and traditions of the people. When she was seated beside the flower for the picture, she said in a quite matter of fact way, "It smells bad." This was a gross understatement.

This flower, like the *Amorphophallus* in your article belongs to the Araceae. Its "dragon-fingered" leaves have some ten digits. And the smell that emanates from a freshly-opened flower is entirely out of proportion to its size and appearance and makes the plant unbearable for use in the house until this stage of its development has passed. The odor is suggestive of an abundant supply of carrion.

The first day that the flower opens is the busiest one for the joyful insects that revel in its vile breath. The scent diminishes and disappears sufficiently within about two days so that the flowers may be kept in the house, sometimes as long as two or three days without fading.

The other photograph shows the fruiting head of the plant, which is also interesting. It resembles to a very slight degree a short ear of corn protruding from its green sheath. As the seeds mature, they acquire a brilliant orange color. The dragon-fingered leaves wither almost as soon as the flower has opened and do not appear again until the following season,

▼ "The Lady and the Dragon" (*Dracunculus vulgaris*)



when they rise from the ground and develop around the stock that is to bear another awful flower of the "vulgar dragon."

If you wish to grow it in a climate where winter brings freezing conditions, the tubers must be lifted and protected during the cold months.

RALPH D. CORNELL

Los Angeles, Calif.

SIRS:

Recently in another magazine I read an account of crows trying to reach water in a deep and narrow earthen jar. Finding their efforts unsuccessful, they dropped pebbles into the jar until the water rose high enough for them to drink. The report is from Ceylon. I would like to know whether anyone has observed crows doing anything like this in this country.

F. D. HAYES

Pittsburgh, Pa.

The following reactions are offered by Dr. Dean Amadon of the American Museum's Bird Department:

It is highly doubtful that crows are intelligent enough to fill a jar with pebbles in order to raise the level of water so that they can reach it. Although crows are unusually "bright" as birds go, such a feat of reasoning would be beyond the mental capacity of any bird, and quite possibly beyond that of any mammal below the human level.

It is well known that crows, and their relatives the magpies and jays, have a strong instinct to hide and store away small bright objects. They also store and bury various kinds of food such as acorns. I would suggest, therefore, that the incident in question may be explained by assuming that the crows were "storing" pebbles, perhaps brightly colored ones, in a concealed place, namely, in the jar. The fact that there was water in the bottom of the jar, which eventually reached a level where the crows could see and drink it, was purely incidental.

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Sul Ja wants her daddy. Every day she looks for him. Every day she asks her mother, "When will Daddy come?" Sul Ja is only four years old. How can her mother explain why Daddy doesn't come—that he still is a prisoner of the Communists in North Korea, that he may even be dead?

Sul Ja's mother doesn't say these things. Like Sul Ja, she hopes that her husband *will* come back some day. In the meantime she struggles desperately to keep her little family together. In war-torn Seoul, where thousands of refugees strive to rebuild their lives, the young mother runs a roadside stand—and makes $10 a month! This does little more than pay the rent, let alone meet the needs of a growing child like Sul Ja.

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continued from page 206

Spirit. Without deer, they cannot prove their manhood. In the deer they have a symbol of their culture.

After spending two weeks in the village, we were called to the council hut. The chief sat in the back. The house was crowded with men. The first two subjects they discussed were the liquor problem and the coming land conference. A blind old man had a great deal to say on both. Then, pointing toward us, he said: "I don't want you people here. You should not witness our ceremonies, which will take place soon. No white man has ever seen them. The permission Papikwana gave you to stay isn't any good, as I am chief now. So it will be better if you retire."

The Kickapoos have a civil and a religious chief, and the religious chief had now taken over for his part of the year. Blind old Achimu was a complete religious fanatic, and we got caught under his regime.

We said that we would not interfere in their religious affairs but wanted only to study their arts and crafts and buy samples.

Achimu continued: "An American man was here, maybe a year and a half ago. He bought lots of stuff. He took it back with him to the museum. If you want to know anything about our stuff, go to the museum and look at it. You can find out everything you want there." Then he walked out, without allowing us to reply.

The council stayed, however. We stated that we would not embarrass them by asking questions about religion but would only deal with games, arts, and living habits. Nevertheless, we were told:

"Our beliefs are like the fingers on your hand. One finger is religion, the others are customs and beliefs. They may seem separate to you, but they really form part of one system, as the fingers form the hand. It is our belief that our games and industries form part of our religion also. They must not be shared. We must go to our God with our beliefs whole in our hand."

As far as we know, this is the first time such an elevated concept of culture has been expressed by an Indian tribe—a real functionalist approach. We were able, however, to secure a reprieve of four more days in which to buy articles of handicraft.

"That's no lady. That's my Uncle Ahmed."

Although the Kickapoo chiefs are determined to keep their culture intact, the five-year drought was a greater shock than they realized, and big cracks are appearing in their defensive walls. When the able-bodied men go to the United States to work, they learn new habits and customs, find new ways of amusement, new styles of dressing, and different ways of thinking. Young women were seen wearing permanents, store-shoes, and store-bought dresses. The young men told us that they wanted more amusements and labor-saving devices.

The medicine men have almost died out. Overalls are replacing loincloths; feathers have gone out. Several Kickapoos secretly showed us crosses, indicating that they were Christians. A few of them own cars. We even saw several baby buggies in the village, used in place of the old cradle-boards.

Political differences disrupt them. Various factions are split in their choice of a chief. Gambling and drunkenness are on the increase. The Mexican group is fighting the use of the drug *peyote,* which the Oklahoma group has been trying to introduce.

We told the chief that customs were changing all over the world and that we wanted to preserve the memory of the proud Kickapoos. We wanted to record their history and arts in a book so that people 100 or 200 years from now could read about them, after all of us have disappeared.

"Two hundred years from now, if there are no more Kickapoo ceremonies, there will not be any people either. The world will come to an end. When the Kickapoo end, the world too will end. Our God has promised this to us. There won't be anybody to read your book."

And that is the mood in which we left them.

The information in this article was collected under the auspices and courtesy of the Milwaukee Public Museum, Milwaukee, Wisconsin.

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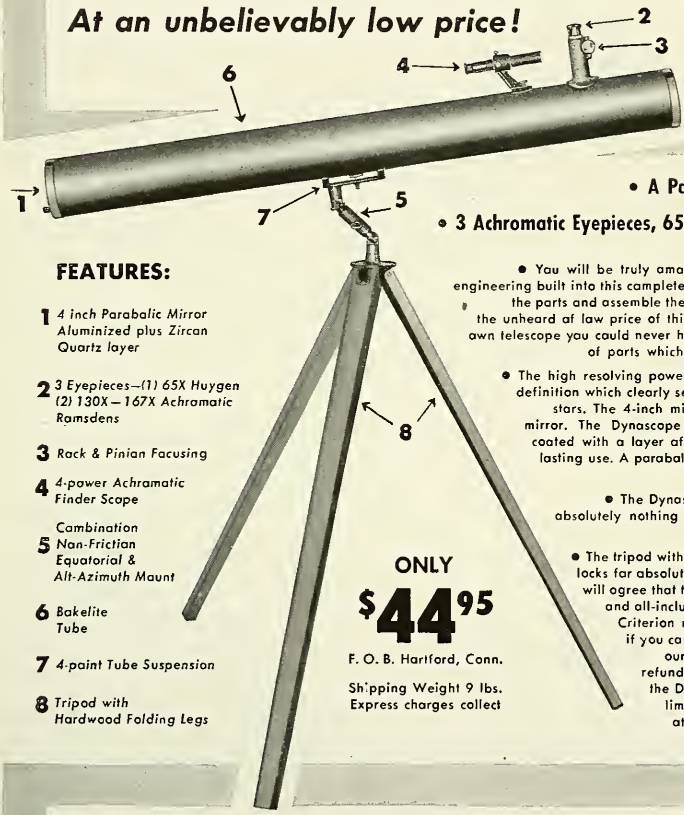

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LETTERS

Bitterns from a Blind

SIRS:

Your interesting article about the little bittern in the Netherlands moves me to offer you the accompanying photograph that I took of the same bird in Kashmir. The photograph shows a pair of the birds. The cock has just arrived to relieve the hen, who is sitting on five eggs. The nest was in a reed bed on the edge of a farm garden at Kutze, a tiny village among the rice fields.

I started observing the nest early in June. Both birds were shy, so I put up a blind and each day carefully cut out a few reeds between it and the nest. When I arrived on the morning of June 28, I saw that three of the young had hatched. That afternoon, the fourth came out of its egg.

The hen continued assiduously to sit on the remaining egg, but the cock was rather casual about it. In fact, I think he would quite readily have deserted that egg had his mate agreed to do so. I do not think it ever hatched.

C. L. BOYLE
Secretary, Fauna Preservation Society
London, England

The Sea Cow's Chilly Cousin

SIRS:

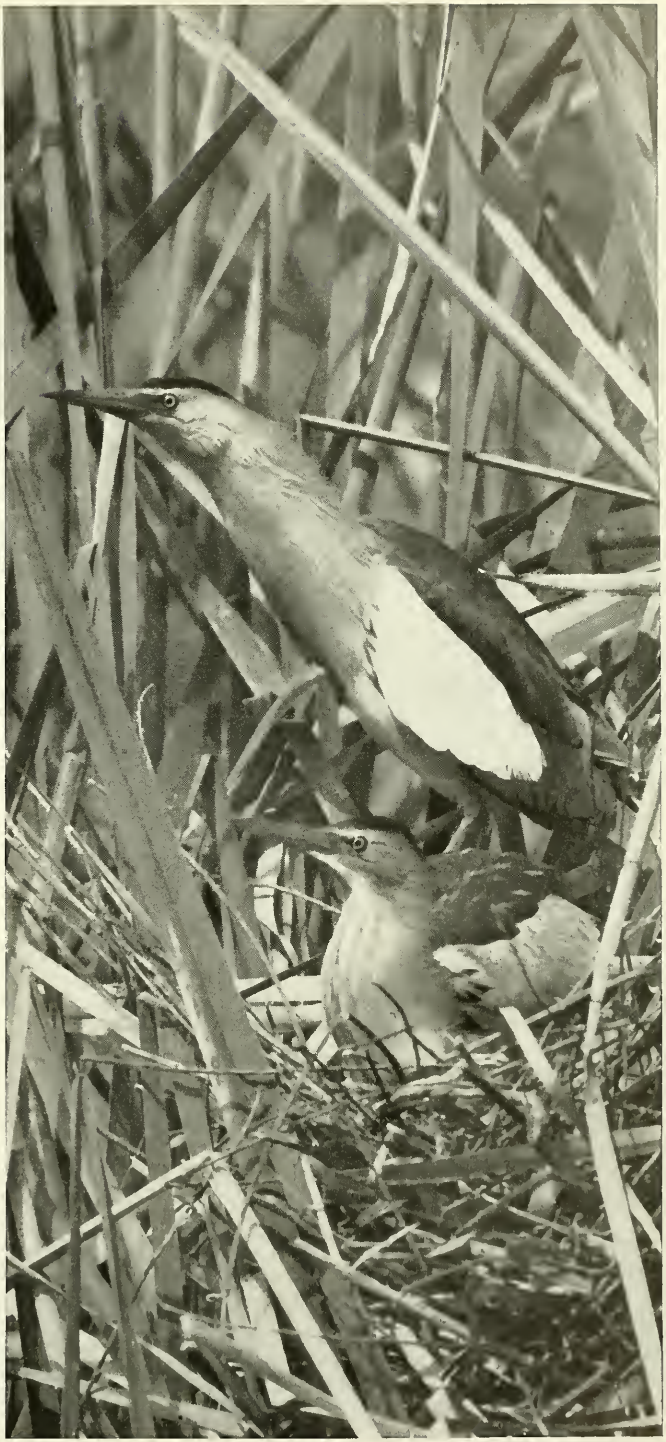
In your short article about the captive sea cows in Florida, you say Sirenians cannot live in cool or cold water and that this has made it difficult for scientists to explain the scattered distribution of these animals, with insurmountable temperature barriers in between. How about Steller's Sea Cow, of the group Sirenia, which survived into historical times in the cool or cold waters near the Asiatic coast of Bering Sea?

HOWARD M. MOSSMAN
Rye, N. Y.

The statement referred to was meant to apply to the existing sea cows which, as mentioned in the preceding paragraph of the article, are the manatees and dugongs. Steller's Sea Cow was a very much larger creature, reaching a length of 25 or 30 feet. A full description can be found in the article entitled "The End of the Great Northern Sea Cow," by George G. Goodwin, in the February, 1946, issue of NATURAL HISTORY Magazine. The manatee and the dugong do appear to be delicately adjusted to mild temperatures, yet are separated by considerable distance of cold water.—ED.

From a Teacher:

...An excellent magazine. I use NATURAL HISTORY for instruction in school classes.



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May, 1955 Volume LXIV, No. 5

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From a color transparency by Charles Walcott and Benjamin Dane

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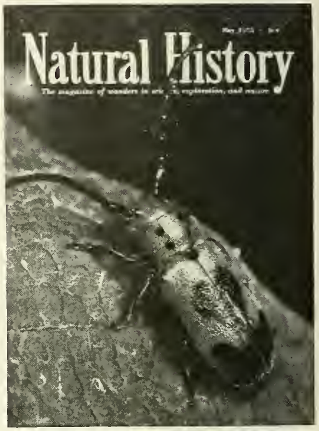

THE COVER THIS MONTH

Although not as large as some long-horned wood-boring beetles (family Cerambycidae), the milkweed long-horn, *Tetraopes canteriator*, is one of the most conspicuous. You will commonly discover its brilliant red and black body resting in the sunshine on the leaves of the various species of milkweed. Approach it stealthily, for at the least hint of danger it will slide to the ground, where it will lie on its back with only its dull gray underside showing.

In midsummer, the female inserts her eggs in a milkweed stem rather close to the ground. As soon as the larvae hatch, they start to eat a tunnel into the pith. In the fall, the full-fed larva pupates either in the ground or in the stem close to the ground. Next spring the adult beetle emerges from its pupa ready to start the cycle anew.

This beetle ranges from eastern United States from Canada to Florida. It differs from a similar and much commoner species, *Tetraopes tetrophthalmus*, by having a black medallion across its wing covers instead of spots.

The photograph was taken by Charles Walcott and Benjamin Dane.

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Bryce Canyon National Park, Utah

"A Mighty Tough Place To Find A Stray Cow"

There it lay at his feet — a chasm three miles long and a thousand feet deep — with myriads of fantastically shaped spires and turrets, towering in flaming array. And Ebenezer Bryce, viewing for the first time the horseshoe-shaped basin that now bears his name, is reported to have said, "A mighty tough place to find a stray cow."

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Geologists will tell you this is erosion at work, with frost, snow and rain patiently sculpturing the soft rocks of Utah's Pink Cliffs. The less scientific have called it music frozen in stone. The music wasn't identified. It could be "America the Beautiful."

Sinclair Salutes the National Grange

Founded in 1866, the Grange is the oldest and largest farm fraternity in the world and has always had a natural interest in conservation and in our National Parks. With headquarters at 744 Jackson Place, Washington, D. C., this organization for many years has been active in promoting soil and water conservation for the farming lands upon which our economy depends. We salute the Grange for its part in creating in Americans the understanding and cooperation so necessary to accomplish this worthy objective.

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MAN MEETS DOG

- - - - - - - - - by Konrad Z. Lorenz

Houghton Mifflin Co., $3.00
211 pp., numerous pen-and-ink drawings

IT is a pleasure to present this new book on dogs and cats to the readers of NATURAL HISTORY. Konrad Z. Lorenz has devoted his life to the study of the behavior which lies behind the bold front of "man's best friend." It is based primarily on his own intimate association with a wide variety of dogs that he has lived with and loved.

Fortunately, Mr. Lorenz does not go into a lengthy technical discourse on pedigreed dogs and how to handle and train them. In fact, when choosing a dog as a friend, he veers away from the highly bred animals and is not in favor of overtraining dogs. On the other hand, the book is extraordinarily interesting from the point of view of animal psychology and the aspect of relationship between dog and man.

Here you will find the author's answers to such questions as: How much of our language does a dog understand? What is a dog's honor code to other creatures, including man living under the same roof? What should you consider when choosing a dog? Many other questions are answered in the course of this narrative that is sympathetic, affectionate and warm, but never sentimental.

Mr. Lorenz gives a plausible explanation of how man met the dog in prehistoric times and eventually made a close intimate friend of it. He traces the ancestry of the modern dog back to two principal sources and shows why animals in both lines of descent have a loyal love for their masters but for very different reasons. He explains that dogs with wolf blood in their veins are quite different in temperament from the jackal-blooded animals. This presents a completely new aspect on the fascinating and complex relationship in the behavior of the dogs we know. In his final analysis, the author advises the reader that a bitch is preferable to a male dog on points of character.

The cat is not neglected, and there is an absorbing account of its ancient history, and relationship to man and dog.

The dog and cat, he points out, are hunters, but the art of killing is entirely free from hatred and there is no resentment toward the animals they intend to kill. Furthermore, these animal hunters are quite unconscious that the quarry is a distant relative and capable of similar emotions. It is this blamelessness of the animal that man seeks to regain when he tries to forget that the object of his slaughter is an animated being like himself, or attempts to deceive himself into believing that his prey is a veritable fiend.

GEORGE G. GOODWIN

A CROSSBOWMAN'S STORY OF THE FIRST EXPLORATION OF THE AMAZON

- - - - - - - - - - - by George Millar

Alfred A. Knopf, $3.95
354 pp., 1 map.

THE adventures of don Francisco de Orellana, the first white man to discover and descend the Amazon River, are so astonishing and incredible that modern tales of Amazonian exploration seem almost anemic by contrast. No matter what unknown tributary of the Amazon system the modern explorer elects to investigate, he knows roughly where he is going, more or less what to expect when he gets there, and, with reasonable luck, how and by what route he will return to civilization. He carries with him wonder drugs and emergency rations as well as the latest field equipment.

Orellana and his 60 Spanish soldiers had none of these advantages. In 1541, under the leadership of Gonzalo Pizarro, they set out from Quito, in what today is Ecuador, to search for El Dorado, the golden dream that lured the *Conquistadores* from New Mexico to Mato Grosso. On the upper Napo River in the Amazonian headwaters the Spaniards ran out of food, and Orellana and his little band were sent downstream to find provisions. Unable to buck the raging current, Orellana never rejoined Pizarro, but continued down river to discover the Amazon and to be branded a traitor. Only grim determination to survive and total ignorance of what lay ahead enabled the party, a year and a half later, to reach the delta of the great river.

Author George Millar has done a magnificent job of relating the hazards and hardships of the Orellana expedition as seen through the eyes of Francisco de Isásaga, a Biscayan scribe who was actually a member of Orellana's party. He has carefully studied the classic historical sources, but has enlivened his narrative by including descriptive material of the fauna, flora, and landscape drawn from the writings of such later authorities as Marcoy, H. W. Bates, and Mrs. Agassiz. This is scholarly history, brilliantly and dramatically retold.

Harry Tschopik, Jr.

AN INTRODUCTION TO ORNITHOLOGY

- - - - - - - - - by George J. Wallace

Macmillan, $8.00, 443 pp., 180 illus.

SO many books about birds have appeared recently that it is somewhat difficult to believe that no up-to-date textbook of ornithology was numbered among them. Professor Wallace's book should satisfactorily fill this gap. Intended for classes at the collegiate level, it contains a reasonably complete treatment of birds, their evolution, distribution, anatomy, classification, habits, and migrations. The numerous illustrations supplement the text to a noteworthy extent, though a few of them are based on photographs of old, battered, mounted birds.

The general reader who lacks formal biological training but is interested in birds will find this book nontechnical and understandable. Its usefulness and scope have been enhanced by including material on methods of bird study, the economic value of birds, and techniques for managing and conserving them.

Dean Amadon

MY WAY OF BECOMING A HUNTER

- - - - - - - by Robert H. Rockwell with Jeanne Rockwell

W. W. Norton & Co., Inc., $3.75, 283 pp., 24 illus.

FROM the very beginning Robert Rockwell knew what he wanted to get out of life and went after it. He followed his natural inclinations with a dogged persistence that carried him far beyond his wildest childhood dreams.

My Way of Becoming a Hunter is the colorful story of the author's graduation from the drudgery of commercial taxidermy to the position of an advanced preparator in the field that created the world's most outstanding habitat groups. In following his aspirations, Mr. Rockwell's career took him on many thrilling adventures to distant fields. He tells of a grueling voyage to the Antarctic on a windjammer for elephant seal and oceanic birds, of his experiences with Carl Akeley on expeditions to Africa where he collected material for the habitat groups of lion, buffalo, giraffe, and other big game. He takes the reader to Alaska for giant bear and to other out of the way places.

Mr. Rockwell's story is told with all the amusing and dramatic details of human interest that hold something of the unforgettable excitement he experienced during his checkered career.

George G. Goodwin

THE LAST OF THE CURLEWS

- - - - - - - - - - by Fred Bodsworth

Dodd, Mead & Co., $3.00, 58 drawings, 128 pp.

THIS is a dramatically conceived work, with a tragic and stirring climax. The illustrations by T. M. Shortt reinforce excellent design and typography in making it a beautiful book to handle and to own. Its theme is the total, irrevocable destruction, solely by "civilized" man, of the once enormously abundant Eskimo curlews.

Mr. Bodsworth's plan and plot are highly original. The 11 fictional chapters dealing with the lives and migrations of the last pair of curlews alternate with a like number of shorter factual quotations under the common title of "The Gantlet." These, printed in capital letters, begin with Forster's original description of the species in 1772 and continue through successive extracts from the minutes of scientific meetings and accounts in technical journals up to a final report published within our own time. All the while the forebodings build, like a Greek chorus, toward doom.

The tale is more or less comparable with *Wild Animals I Have Known*, but it is not equal to Ernest Thompson Seton's masterpiece either as story-telling or as a convincing portrayal of animal behavior. The author has, perforce, too little precise information to support the length of his text. There are statements and inferences both dubious and downright incorrect to jar the sensibilities of a reader versed in the field, and we are told far too many times that there was "little mental reasoning involved" in the response of the curlews to various environmental stimuli.

Nevertheless, the book is by no means lacking in truth as well as charm, and it undeniably drives home a bitter lesson.

R. C. M.

BEES ARE MY BUSINESS

- - - - - - - by Harry J. Whitcombe with John Scott Douglas

G. P. Putnam's Sons, $3.75, 245 pp., 12 illus.

BEES have been a source of interest to Harry Whitcombe since childhood and a source of livelihood for two decades. He can justifiably claim, therefore, that bees are his business. But in a somewhat different sense bees are also the business

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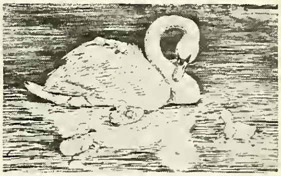

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of everyone, for without the co-operation of these tiny helpers the lot of man might be far more precarious than it is. Faced with expanding human populations, there is an increasing demand for more and more products of the earth. The bees through their pollinating activities and the bee-keeper through wise utilization of his colonies play an important role in assuring adequate food resources

The preparation and distribution of "package bees" to meet the needs of bee-keepers and orchardists is one of the important activities of Harry Whitcombe, who operates from California. He calculates that annually half a million two-to five-pound packages of bees are shipped and, as some 10,000 bees are required to fill even a two-pound package, the aggregate of bees available for pollination in new regions is impressive.

Hives are also transported by truck in migratory fashion and rented for requisite periods to those who have fruit trees or other plants in need of the visitation by bees. Highly encouraging results have been obtained in the yield of seed of alfalfa, thanks to what is described as "saturation" of a field with bees. The author aided in the development of this technique. He was instrumental also in devising a pollen trap that made possible the recapture of substantial loads of pollen from returning foragers.

The writing is so deft and clear that the reader is hardly aware he is being presented with information. Notwithstanding the author's disclaimer, this autobiography reads like a "success story," with ultimate security taking shape out of circumstances often discouraging. As a success story and for the light it throws on bee-keeping, it should prove alluring to apiarists and potential apiarists.

HERBERT F. SCHWARZ

TROPICAL FISH IN THE HOME AQUARIUM

- - - - - - - - - - by Horace Vondys

The McBride Co., $3.00,
157 pp., 18 illus.

READING a book does not tell you how much work went into writing it. Mountainous efforts sometimes lead to mouse-sized results, and once in a while genius spawns a miracle with little effort. Nevertheless, there are times when the reader feels he can almost see the author at work.

I do not know the author of this book, but he must be one of the old-timers in the tropical fish hobby with long, rich years of experience behind him. He apparently kept fishes as pets before the days of electric lights, for he graphically describes the difficulties then inherent in keeping fish at home. I picture Mr. Vondys sitting down and committing his

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reminiscences to paper, just as he might recount them to some tyro who came to him for advice. Mr. Vondys has a well-ordered mind that finds expression in a simple, straightforward style well suited for this kind of book. But he seems to have depended upon it exclusively, and has consulted neither authority nor library reference to check a fact, substantiate an idea, or even to find out how to spell a name correctly.

Unfortunately, Mr. Vondys' knowledge and personal experience are far from universal, and his memory has played him many tricks. For example, I have found errors—the great majority of which can only be described as inexcusable—on 52 of the book's 157 pages! Whatever merit this book might have as a record of how one experienced aquarist takes care of his fish is far overshadowed by the host of errors and half-truths it contains.

JAMES W. ATZ

SONG OF THE SKY

- - - - - - - - - - by Guy Murchie

Houghton Mifflin Company, $5.00
423 pages, 70 drawings by the author

ANYONE who has spent the quiet hours of a night watch on the bridge of a ship or in the cockpit of a plane knows how repetitious the hours are, with only occasional duties. One inevitably turns to musing on the natural world about him. Guy Murchie, one of these observers by necessity, has derived from his travels an understanding of the beauty and arrangement of the air ocean, including what moves in it and below it. As an aircraft navigator with extensive experience, he writes with the authority of one subjectively surveying his own element.

It is difficult to classify this volume. In many respects, it rates as a textbook, containing descriptive accounts of the basic problems in celestial navigation, the facts of lightning, thunder, clouds, precipitation, and frontal theory. Yet each of these subjects is the basis for a narrative so fascinatingly woven that one wouldn't suspect that teaching and learning are inherent in its make-up. In addition, Mr. Murchie might well be counted as a prose poet because of the sound quality of the words he uses to describe physical relationships in this book.

This reader's attention was caught by the many accounts of airplane mishaps or near mishaps that are inserted frequently to stress the importance of some seemingly commonplace meteorological condition. Many airplane accidents are described so vividly that the reader nearly senses that he is re-living the minutes of the events narrated.

One incident, typifying the flavor of the book, is reflected in an account of a navigator who made a "dry tank" landing with a cargo of generals during World War II, and later had a similarly narrow

continued on page 279

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How did the Ancients do it?

Without any of the mechanical aids we take for granted, the people of old erected some of the most stupendous structures to be seen on earth today

By Herbert J. Spinden
Curator Emeritus of American Indian Arts and Primitive Cultures, Brooklyn Museum

ATOP a skyscraper in any modern city, you see what derricks and elevators can build of steel and stone. But most of the stones used in our skyscrapers are puny compared with the ones that the ancients cut out of solid rock and moved by manpower alone. At Stonehenge, about 80 miles west of London, the primitive people erected upright stones 22 feet high and placed a capstone 15 feet long on top of them. They did this with no draft animals and with no engineering science as we know it. How did they do it?

The answer of the archaeologist is: "They did it the hard way" They probably built an inclined road and dragged the stones up it, possibly on primitive sledges with mud as a lubricant. At the top, they toppled the columns over and implanted them in an upright position. The crosspiece was then slid into place as shown below.

The same answer of hard work and know-how must have sufficed with many other megalithic, or "big stone," projects. The Great Pyramid of Cheops, one of the Seven Wonders of the World, is a solid mass of limestone blocks covering thirteen acres. The lower blocks weigh up to five tons; the upper ones are somewhat smaller. The total weight of about 5 million tons was moved into position mostly by human power; and it is generally agreed that the early Egyptians did not have rollers to ease the task. Canals were plentiful in this region, and high water helped to float bargeloads close to the site. But the heavy stones were then pulled up inclined roads and coaxed into place.

When in 1924 the Egyptologist Ludlow Bull summarized the modernity of ancient Egypt,[*] he explained that the power of the Pharaohs increased during the 500 years before Cheops to a point where this ruler was "able to keep 100,000 men . . . working for 20 to 30 years to quarry 2½ million blocks of stone, each weighing from two to five tons, and to pile these up in a great mountain covering thirteen acres on the ground and rising 450 feet into the air, nearly as high as the Washington Monument—all this solely to receive the discarded carcass of one man." For the Pyramids were primarily tombs of kings.

The Pyramids of Gizeh set a standard impossible for the ancient Egyptians to maintain through the centuries, but the Pharaohs continued to build other massive monuments, including innumerable colossal monolithic statues, some nearly 70 feet high and weighing several hundred tons. These were cut out at the quarries and hauled on skids to the river. Ludlow Bull goes on to tell that it was not customary for the Egyptians to quarry in the summer, because it was at that season that the material could better be transported on the high Nile.

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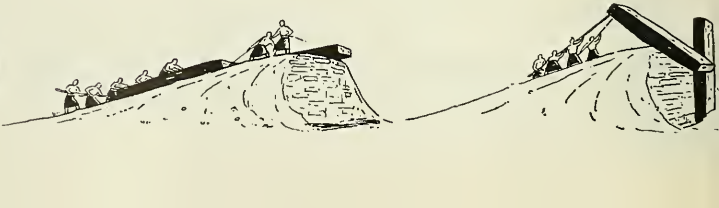
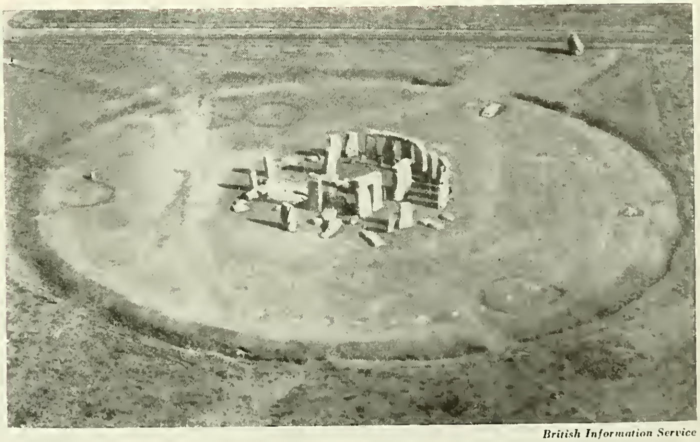
[*] "What Kind of a Modern Was the Ancient Egyptian?"—*World's Work,* July, 1924.



➤ THE BUILDERS of Stonehenge almost certainly used the inclined plane. It has the effect of stretching the time in which one can apply his strength in raising a weight.

Ewing Galloway

ALMOST INCONCEIVABLE TOIL was necessary for the prehistoric people of southern Britain to build Stonehenge. Air photography discloses a road ascending from a quarry, and the stones were probably set in place as shown below. We have no eyewitness account of how it was used, but it was probably a temple for sun worship. A 300-foot circular moat surrounds the ruins.



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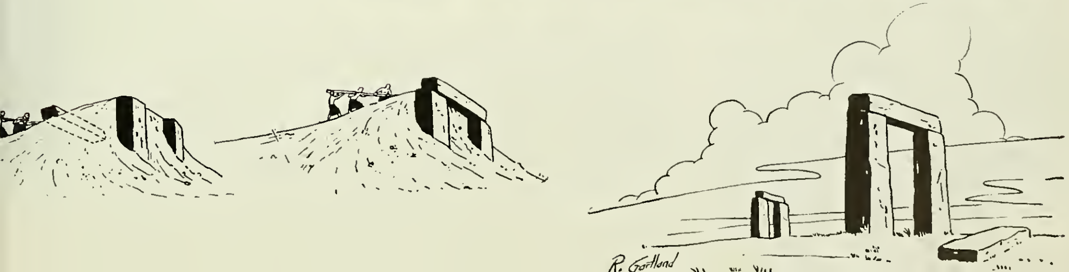

AMNH

▲ On Easter Island, another people found expression for their artistic or spiritual ideals in works of superhuman size.

▼ One of the 70-foot Colossi of Memnon. Modern man still wonders how the Egyptians could move such heavy statues so far.

Philip Gendreau

"The workers in the granite quarries of Aswan," he writes, "or those who took limestone from Troia in the Mokattam Hills near modern Cairo, or alabaster from Hatnub in the eastern desert back of El-amarna, or sandstone from Silsileh below the first cataract must have had somewhat better fortune, for they were within or near the Nile Valley itself and the labor of dragging stone down to the ships was much less." At the river's edge, the stones were placed on great barges and transported to their destinations, where they were brought ashore and again hauled on sledges to the sites prepared for them and then set up.

Chiefly Religious

In other parts of the world, it was to glorify a man or event that early people constructed gigantic monuments like the Inca fortress of Sacsahuaman, which looks down on Cuzco in Peru. Other great buildings of the past were erected for religious purposes, such as the massive Cambodian structures in the jungles of southeastern Asia and the Maya temples of Yucatán. Whether conceived as an expression of the ego of a powerful individual or as a

▼ Warner Brothers' "Land of the Pharaohs" re-enacts the building of the pyramids. Below: hauling a block from the barge to the base, then up a ramp and into position. Finished work (opposite page) stunned the ages.

Warner Brothers

tribute to a god, these great edifices required the concerted physical effort of great numbers of individuals. In many cases the workmen were slaves.

For this reason, great works like these could not be built before man had cast off nomadism and built himself settled communities. Also, in most instances he had domesticated plants on a considerable scale and also animals, though the latter may not have been useful as draft animals.

But the story of man as an engineer begins much farther back. His rise above the animals is seen in the invention of tools that gave his hand a mechanical advantage. In one instance, huge monuments were carved of stone and raised into position by people in one of the most isolated spots on earth—Easter Island. Some of the human statues that they carved are as high as 30 or 40 feet. Many persons have wondered how these stone figures could have been raised by the primitive populations that originally inhabited this 46-square-mile island in the Pacific Ocean about 2000 miles west of Chile. Dr. Harry L. Shapiro, who visited the island in 1935, mentions how some persons have thought "that a huge population was necessary to account for the manufacture and transportation of these Goliaths in stone. La Perouse minimizes the difficulty by saying that a couple of levers and rollers were ample to move them. But levers and rollers of what in a treeless island?"* Some of the stones, weighing tons, were moved fifteen miles and then set up on stone platforms. The possibility that the island is a relic of a once much larger land mass is not borne out by geological evidence or by the distribution of the monuments themselves, which for the most part follow the present coastline.

In all likelihood, the monuments were carved and moved in a time when the island looked very much as it does now, by people predominantly Polynesian in culture, though possibly having a mixture of Melanesian. Estimates of early travelers indicate that there were between 1000 and 2000 of these natives on the island when it was first visited. However, the statues of Easter Island should not rank as a first-class engineering feat, because they are carved of soft and lightweight volcanic stone.

Man's early efforts to shape and move huge stones are interesting not only because we are sometimes

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*"Mystery Island of the Pacific," NATURAL HISTORY Magazine, May, 1935, pp. 365-377.

Trans World Airlines, Inc.

Philip Gendreau

unable to guess how he succeeded but also because these ancient accomplishments show so clearly the determination of the human race down through all the stages of history to gain control over the physical world. Man has never been the most powerful creature physically, yet from the dawn of his culture down to modern times, it seems to have been his ambition to gain mastery over his environment. This has been possible only through the exercise of mental ingenuity.

Today, engineering science and nuclear physics seem the complex outgrowths of a tendency we see clearly in the megalithic monuments of old. Yet there is also beauty in the gigantic columns of Karnak and Baalbek, showing that an expression of brute force was never the main theme in man's spirit of self-assertion but that an esthetic and spiritual ideal almost always stirred him even in the face of well-nigh impossible physical tasks.

So we see that man's great potentialities were deeply rooted in an adventurous youth. Beginning with mastery over fire, wind, and water, our ancestors asserted their desire for physical supremacy through a series of inventions that brought the energies of their environment within useful grasp and greatly improved upon the power of unaided muscle. Man's higher thinking burst into flame spontaneously and spread with *Homo Sapiens* into widely separated regions of the earth, and not so long ago, as the general evolution of the earth is measured. Even allowing something less than the traditional three score years and

BAALBEK's massive columns may have been late enough for some sort of derrick to be used. The wheel pulley seems to have been known by 800 B.C.. in Assyria. Below: Some of the 134 pillars in Ramses II's Temple of Karnak.

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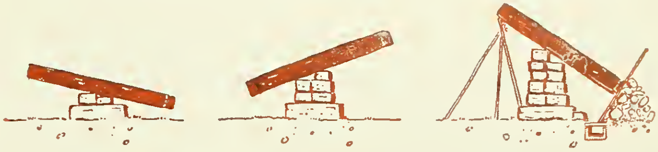
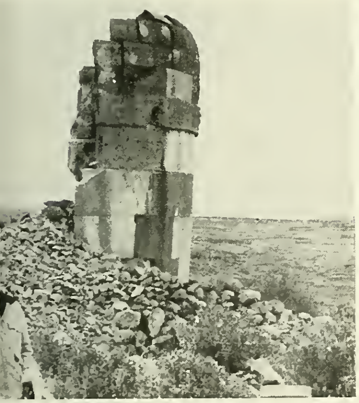
ten, a hundred lives touching fingertips (the old man-young boy unit) takes us back to man's earliest settlements with wheat farms and livestock pastures, also to his earliest wind and water mills to irrigate fields and grind flour, and to the first sails that propelled ships and to draft furnaces that smelted metals along the Nile and the Euphrates. Even more recently priests and kings boasted of the pyramidal ziggurats in Babylonia and the stepped pyramids in Egypt.

▼ In teetering heavy stones upright, the Mayas showed their talent for dynamic as opposed to static (Old World) engineering.



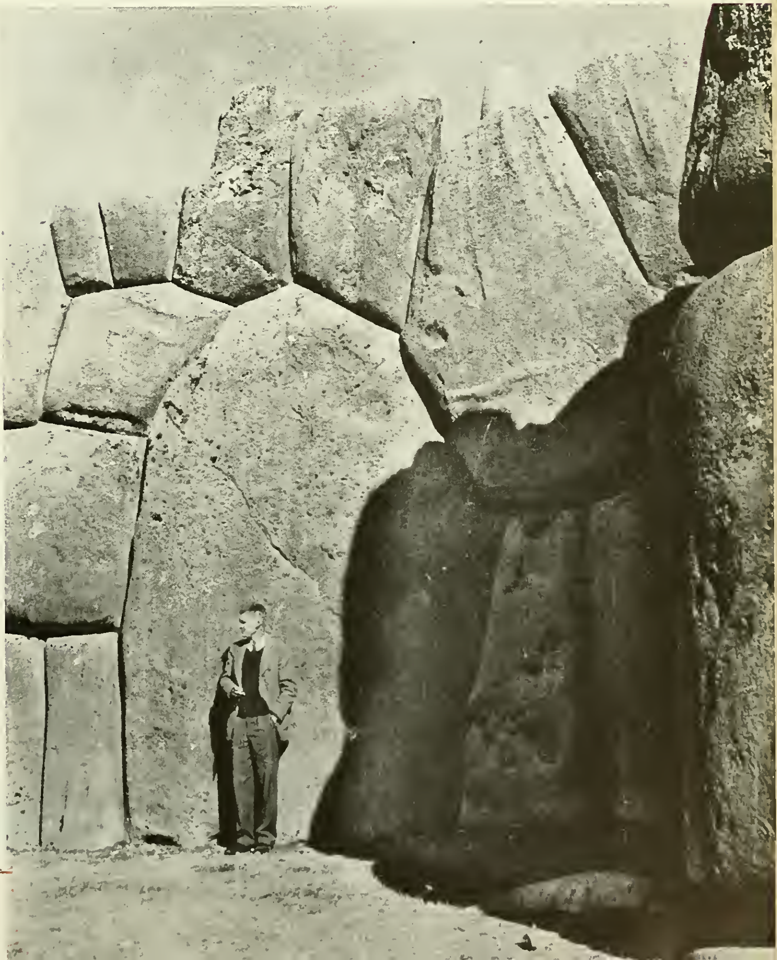
Basic Inventions

The beginnings of engineering science can be seen in these heroic undertakings and in the clues to early use of the inclined plane, the lever, and the wheel, upon which so many of our intricate machines are based. The inclined plane has the effect of stretching the time in which one can apply his physical strength to the raising of a weight any given distance. The result is that a small force, continuously applied, can lift a large mass. The lever, in a slightly different manner, spreads the work of raising or moving a heavy object in such a way that less force need be applied at any one moment. The wheel and roller reduce friction, of course. Precise dates are seldom available for many important tools invented before the days of recorded history. The slip pulley, not yet wheel-bearing, is an old easement device for raising sails in the Old World or loading draft animals there and in old Peru. The taming of spirited horses in the Far East inspired the chariot; other wheels were common in Babylon, Egypt, Greece, and Rome but absent from the Western Hemisphere except in play-

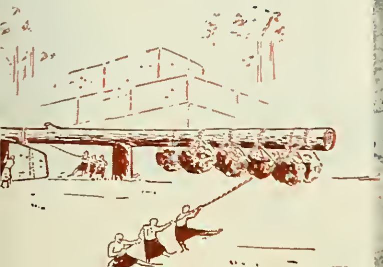


Horry Tschopik, Jr. photos

▲ Not often did the ancient engineers leave a clue to their method as in this ramp in Sillustani in Peru.



➤ Some of South America's most imposing stonework was in the Fortress of Sacsahuaman near Cuzco, Peru. Below, we see how people who understood the balance-arm for weighing things may have "walked" large stones into place.



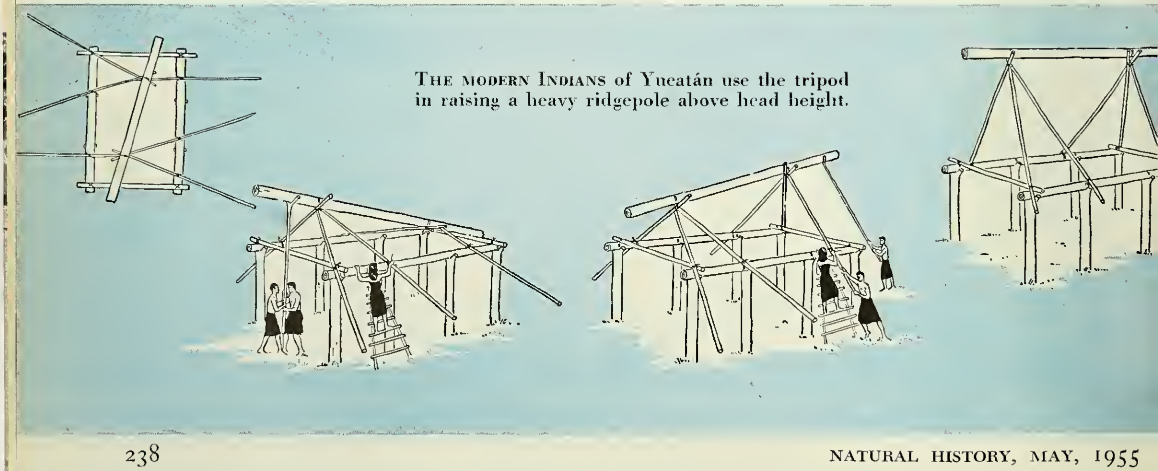
things in clay or gold from Mexico to Panama. The roller was probably widespread in ancient cultures. The flywheel, used early in the spindle whorl and the fire drill, was more important in its ultimate implications than the wagon wheel.

If the reader has seen the monuments of Yucatán, he will agree that the Maya Indians had a well-developed skyscraper ambition. Their modern descendants know at least one trick in the raising of heavy timbers, as I once had opportunity to observe in central Yucatán. Before one builds a skyscraper with stone vaults, one must learn to build a house, and the process I watched may have come down from early times in that part of the world. I have never seen it described elsewhere. Anyone who has taken part in raising a ridgeboard to its proper position in a modern house will appreciate, I believe, the ingenuity of this method. It gives the necessary mechanical advantage without using a wheel, lever, inclined plane, or pulley. It is also the only primitive method I know of that makes the raising of a weight overhead easier the higher you go.

Two men and a woman were building this house without a saw, a hammer, or a nail. The posts and beams had been cut and trimmed with bush knives, replacing, I suppose, the stone axes of older days. There were piles of looped *bejucas* (not vines so much as the long, slender air roots of plants resting in

Ewing Galloway

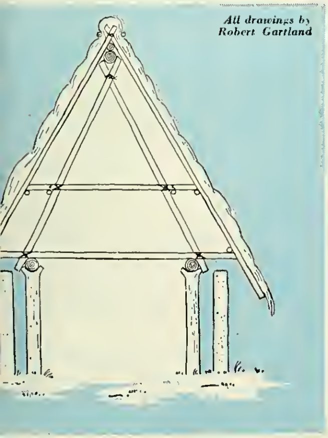
▲ THE MAYAS had skyscraper aspirations and were good at upending heavy stones. Though their temples were largely of reasonable-sized stones, they were massive and artistic. Building them required patience and teamwork.



THE MODERN INDIANS of Yucatán use the tripod in raising a heavy ridgepole above head height.

high trees.) The Belize Negroes call these cordlike air roots *tie-tie*, and the large ones used for lashing heavy beams are *bellyful tie-tie* because it takes a well-fed man to dislodge the larger plants. When I arrived at the scene, eight posts had already been set in holes in the ground to form a rectangle, and beams had been laid along their forked tops. Crossbeams with projecting ends had also been put in place, and a heavy ridgepole was lying on them, as shown in the accompanying drawing. It had been lifted up, one end at a time, without too much difficulty, for the height was not great. I now saw two large tripods spread out flat on top of the beams but underneath each end of the ridgepole. The legs of these tripods were lashed by an adjustable knot to the beams on either side of the house, two legs on one beam, one on the other. A forked pole was tied near the center of the ridgepole to serve as a steering rod.

When the lifting began, one man would hump up a tripod leg while the other steadied the ridgepole with the steering rod and the woman held the gain in height with a quick hitch. In this manner, each tripod leg was jacked up a little and lashed, and the ridgepole was raised with little effort at difficult heights. The process continued until each of the six legs was in the proper position to bring the ridgepole in place at the apex of the house frame. The tripods were then firmly lashed to the horizontal framing in permanent position. The first part of the lift was easy because the weight of the pole was not yet far overhead, and the latter part of the lift was easy because after it might otherwise have become difficult to balance the weight, the tripods had risen to a stable position. The legs of the tripods were then slid together horizontally for a considerable distance in order to raise the ridgepole a matter of inches.



All drawings by Robert Gartland

Because free circulation of air is important, the thatching of the roof of the Maya house is actually on a second framework, which spreads a few feet beyond the eaves of this first one, as shown in the drawings. And in the larger houses, an outer row of house posts may be erected to support the ends of this outrigging. What this amounts to is a second construction laid over the first, with a lighter ridgepole immediately above the heavy one. The thatch may be lapped over the ridge to make it rainproof.

The Tripod as a Tool

The tripod as a lifting device seems to have been developed independently and exclusively by the Indians. It is the only simple lifting device that makes lifting easier the higher you go. Hands or shoulders can help at the beginning, and once the pole is overhead, the principle reaches full utility. For then each time one of the feet is moved a foot, the weight is lifted only inches. The tripod was used in somewhat different form in the tepees of the Indians of the Plains, in which many poles are cinched near the top. But here, the cinch becomes a slip pulley when a single squaw tosses a rope across the apex and hauls her tent cover upward.

Another ingenious use of the tripod is seen in South America. Certain Indians are known to erect three tripods in a triangle to support three hammocks when camping on a river bar. Inventions of this sort may seem trivial in our technical era, but they are really indicative of great ingenuity.

The Maya tripod-jack may even have prepared the reasoning of the Maya priests for their remarkable and distinctive mathematical system. This system enabled them to solve mathematical problems involving three incommensurable quantities by bringing them together to a common apex of integration in a pattern of thought inescapably similar to the three converging legs of the tripod. They applied this system to astronomy in a way that is seen nowhere else in the world, to reckon time from a definite point in astronomical history. But it would be beyond the scope of the present article to discuss this in detail.

Study indicates that the Mayas erected their massive stones by teetering and blocking, whether or not this was the case elsewhere in the world. The tallest monoliths of Quiriguá, in eastern Guatemala, were moved two miles from exposed ledges, where rough blocks had been separated along natural cleavage lines, to the city plaza. A cobblestone road has been located, over which it seems likely the stones were moved by skidding on stone-boats, with mud as a lubricant. In the plaza, they were set up over cavities containing religious offerings. Each stone, after being balanced across a flat stone with a pit on either side, was tilted seesaw fashion by men walking alternately from one end to the other. When the stone had been blocked high enough, it was slid into place over its cavity.

In Peru, huge and seemingly unmanageable stones were slid snugly into place to form some of the most astonishing walls of ancient times. A counterweighting technique based on the principle of the lever may have been used. The wonderfully fitted stones of great size at Sacsahuaman are natural boulders of diorite transported from afar and neatly joined together at the site. The largest measured stone is 18 feet high, 36 feet long, and 6

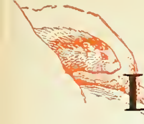
continued on page 278

Whistler in Boots

Though he sleeps more than half the year, the hoary marmot becomes a rollicking clown when fully awake

By Will Barker

Illustrations by Bob Hines



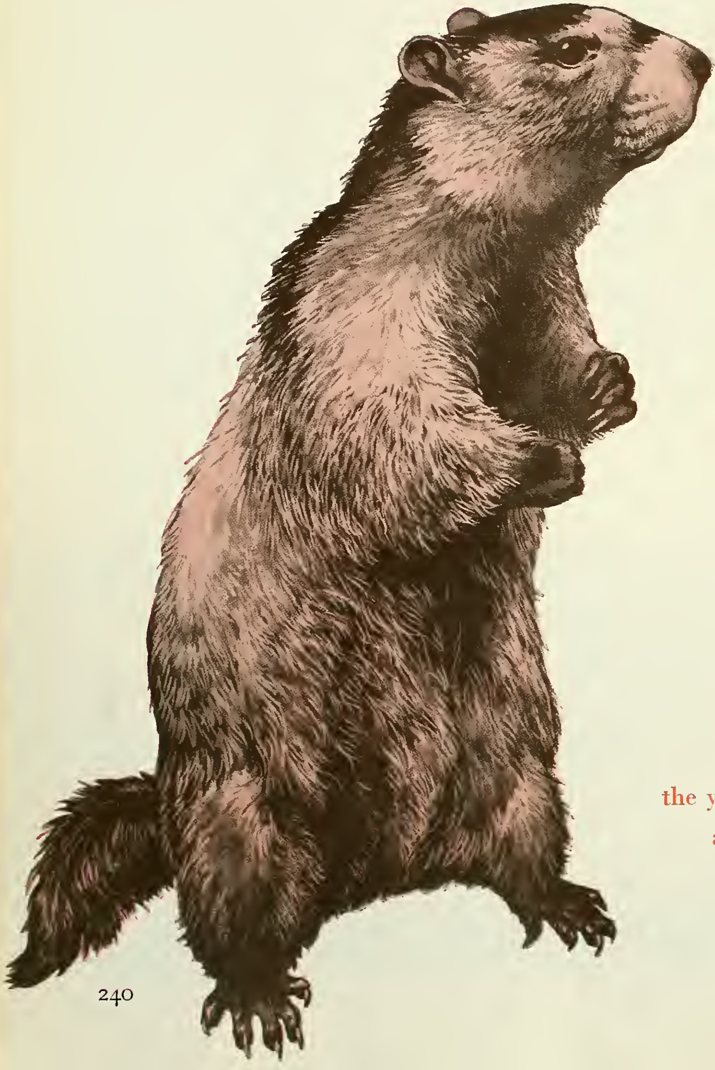
LIKE Ferdinand the Bull, the hoary marmot is fond of flowers. But he is not content with merely sniffing them; for the marmot, or whistler, is a vegetarian who enjoys wild-lettuce blossoms and other mountain flowers as part of his regular diet. He munches the petals with the air of a gourmet savoring a favorite gastronomical delight.

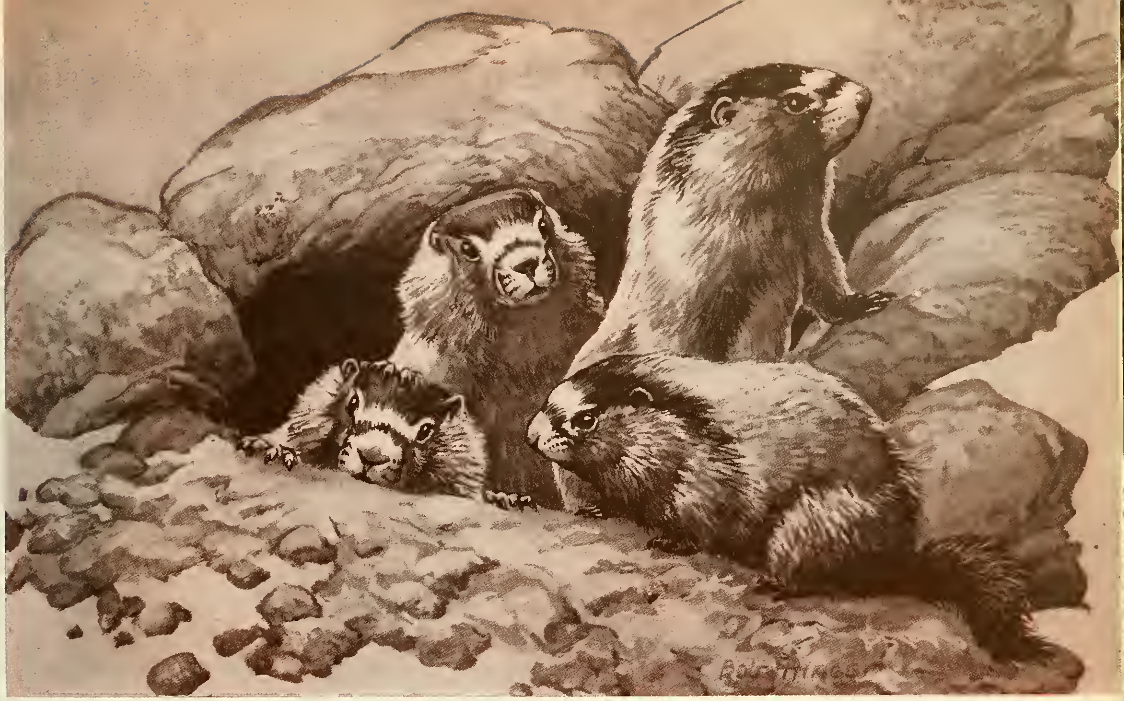
The hoary marmot lives at or near the timber line on rock-strewn and flowery slopes of mountains, and may be found from northwestern Alaska and the Alaska Peninsula to central Washington and Idaho. He is about twice the size of the common woodchuck and looks as if he had on blackish-brown boots, or *caligae,* the Roman name for military boots—hence his scientific name of *Marmota caligata.* Full face, he appears rather bulky, but actually he is a slim, almost skinny animal with a fine coat of gray-black fur, frosted with white.

When eating his flowers, the marmot stands up and grips nodding white stalks of wild lettuce or swaying blue spikes of lupines between his forepaws, then pulls them down to nip off the blossoms. He also relishes mountain phlox and rosy douglasia, along with wild vegetables like shining white onions. After unearthing onions, the marmot rears up and holds the bulbs in his paws to nibble off rootlets. Sometimes the bulbs themselves are eaten, but more often they are passed up.

Marmots are playful, noisy, and sociable. They often engage in antics suggesting a dance. One animal extends an invitation by tapping another on the shoulder, and the enticement is seldom spurned. The partners "dance" with their bodies arched upright, nose to nose and forepaws to forepaws. Suddenly, as if on signal from an unseen caller, they push away, circling backward, only to swing into place again with such force that their buck teeth meet with a sound like colliding billiard balls. The dance ends when one partner breaks away and races off to drop down exhausted.

Dancing is not the only kind of marmot recreation. They like tobog-





▲ CAUTIOUS YOUNG WHISTLERS survey an alpine landscape from the entrance to their snug burrow among the rocks.

ganing. In the spring, not long after hibernation and before the winter snows are gone, marmots will deliberately run downhill, brake themselves, and then skid for ten feet or so. In the summer, when two or more are frisking around the entrance to a burrow, one marmot is quite likely to rear up suddenly and fling himself down the slope, tail-over-teakettle, to be followed in similar fashion by his companions.

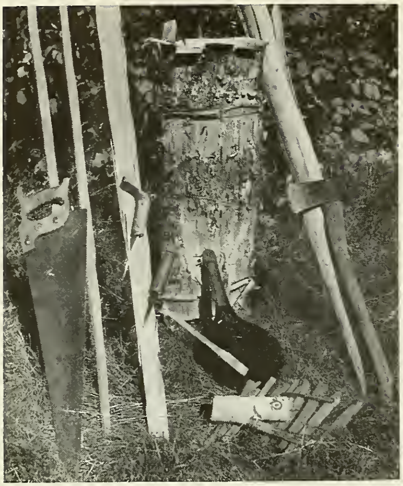
Although marmots like to frolic, they are ever on the lookout for danger. This is announced by a shrill blast, which caused French-Canadian fur traders in the Rockies to call the marmot *le siffleur,* a name shared with the woodchuck of eastern Canada. It is a name that should belong solely to the hoary marmot, whose whistle can be heard a full mile on a windless day. The yellow-bellied marmot, a first cousin, is a poor second when it comes to sounding an alarm, and the woodchuck, another cousin, is more a chirper than a whistler.

The hoary marmot's whistle, sounded from a rocky lookout, alerts every living thing within earshot, including the grizzly bear, which, paradoxically, likes marmot meat. All inhabitants of the heights pause in their various activities to see what's up, while the marmots drop down out of sight in their burrows among the rocks. When the danger is past, a sentry gives a low whistle—apparently an all-clear—and marmots pop out all over the village like so many jack-in-the-boxes. As a safeguard against golden eagles, marmots dig shallow shelter holes along the pathways and duck into them when an eagle starts a threatening swoop.

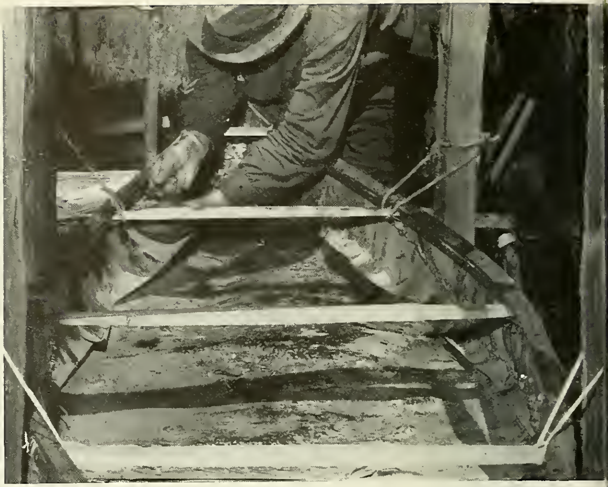
A marmot spends about 7½ out of 12 months in hibernation, an interlude of suspended animation. He awakens from his long winter sleep early in the spring, the exact date depending upon the altitude or latitude. He may tunnel up through as much as ten feet of snow to make his yearly debut, and then find that there is little food around when he emerges. It doesn't seem to matter, though, for at first he acts as if drugged, taking little interest in the world around him. Then, as the snow melts and the greening of the plants begins, he starts to eat, gorging until his belly drags the ground. He also refurbishes his den, hauling out damp, winter-worn hay and bringing in freshly-cut grasses from near-by mountain meadows.

An appropriate marmot motto might be the warning about all work and no play, for routines are frequently interrupted for dancing or downhill somersaulting.

As a rule, hoary marmots do not mate until they are about two years old. The four or five offspring of the union are on their own by the time the mother is preparing for hibernation. All marmots get set for this period by fattening themselves to the bursting point. Then, snug in winter-proof burrows, they curl up into tight little balls—safe for another 7½ months from enemies who like the flavor of flower-eating marmots.



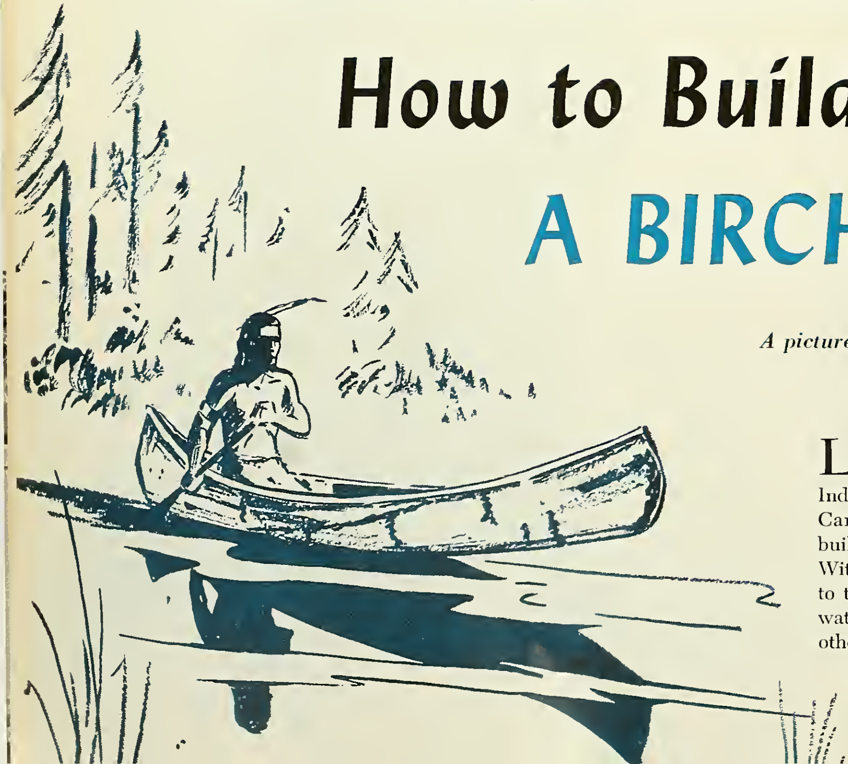
▲ From the forests Dan took materials used to make bark canoes from time immemorial: white birch bark for the covering; white cedar for the frame, and black ash for lacing (spruce or pine roots were also used). The tools, with some concessions to modern practice, are "crooked knife," square awl, saw, penknife, birch mallet, frying pan to heat rosin. and gauge sticks to measure sheer and depth of the canoe. Steel-bladed tools have replaced stone.



▲ The bark is trimmed after it has been fastened to 13-foot gunwales and the hull slung from posts for rib-fitting. Extra pieces were required at the sides; and the hull was slit and overlapped at two-foot intervals for shaping. The gunwales are cedar strips, three to a side. They are held apart by birch thwarts. Nails have been used here, together with ash lacings and wooden pegs. The smooth inner side of the bark goes next to the water to decrease friction.

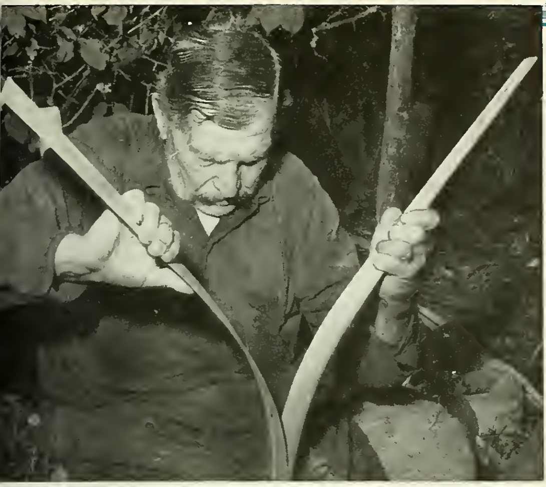
At 82, Dan of the Montagnais tribe of Canada practices an almost vanished art

How to Build A BIRCHBARK



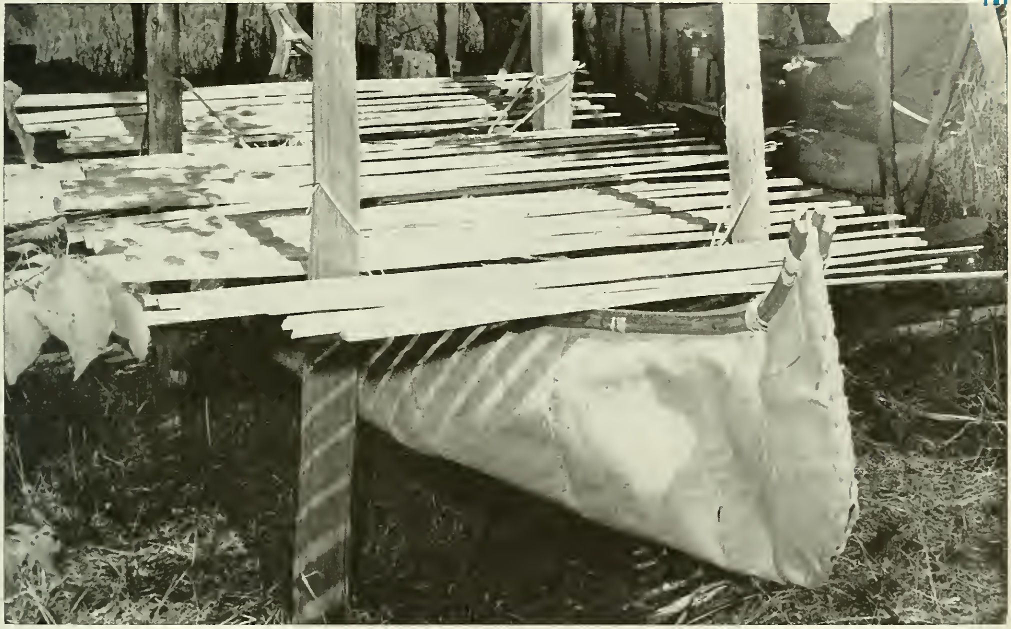
A picture story by Eugene W. Bond

Long before Columbus was born, the Eastern Woodland Indians and their brothers of the Canadian Northwest learned to build the lightweight bark canoe. With it they followed the streams to their upper courses, crossed the watersheds, and floated down into other river systems. Later, explorers



< **White cedar** is split into ribs and sheathing strips (lengthwise strengtheners). Its lightweight and straight grain make it ideal for this purpose. Ribs are made $2\frac{1}{2}$ inches wide by $\frac{3}{8}$ inch thick; sheathing strips are made 3 inches wide by $\frac{1}{8}$th inch thick.

∨ **Unshaped ribs** are laid in position on the gunwales. When they are curved into shape and installed, the wrinkled bark will be stretched smooth. The lacings will be smeared with waterproof pine pitch. Note that whereas most boats are built frame first, covering afterward, the bark canoe is built in the reverse of this process.

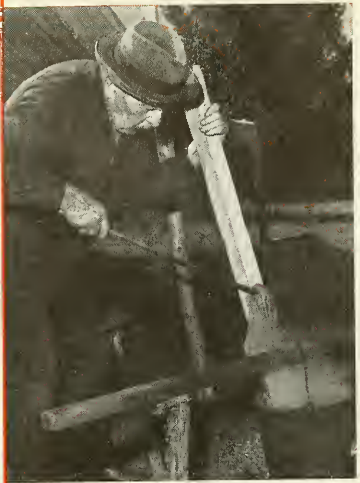


traveling with them were able to penetrate regions where the forests were sometimes well-nigh trackless.

The birchbark was used by the Indians of the Great Lakes region and the Northwest. But the elm bark canoe took its place among some tribes, particularly the Iroquois. In the south the dugout was made. The Penobscot of Maine sometimes used a moosehide canoe.

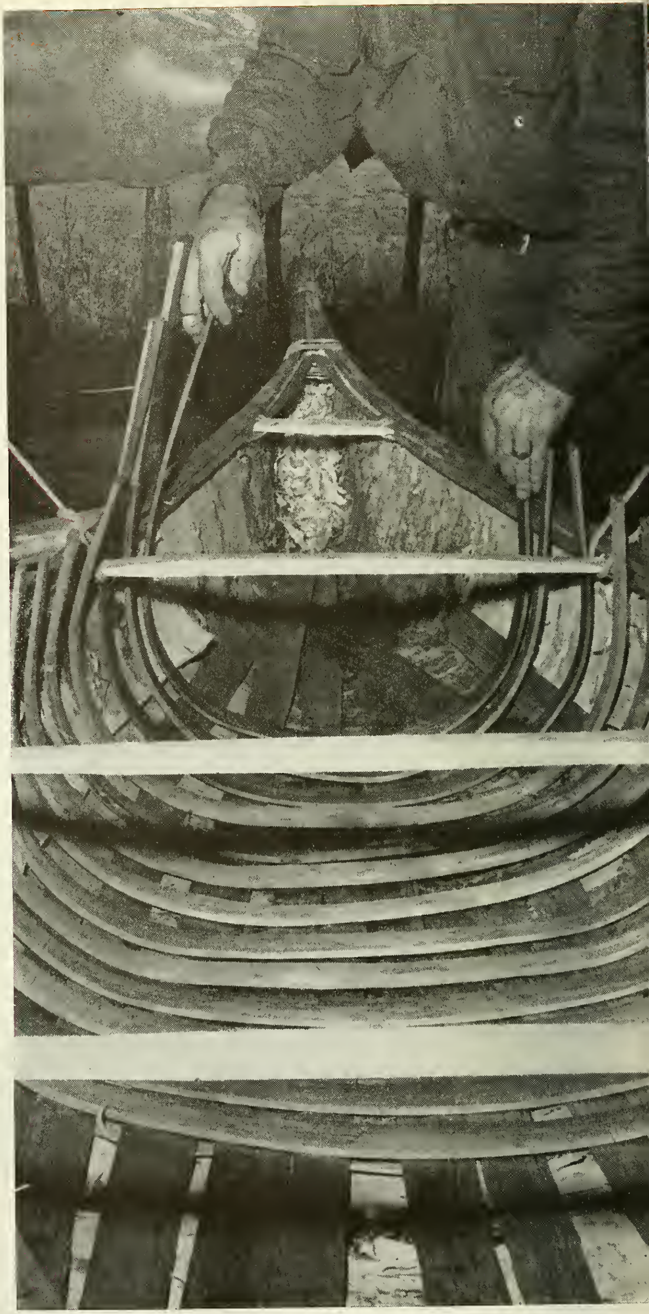
But the birchbark canoe was the indispensable feature in the lives of many of the tribes that our early colonists knew best, and it became a symbol of the romantic literature of the early frontier. Since the birchbark canoe has all but vanished except in museum collections, these photographs have unique historical interest.

In addition to canoes, the Indians used birchbark in making houses, pails, dishes, and boxes. Some of the Great Lakes Indians used it as paper and made writing tablets in which to inscribe simple picture writing.

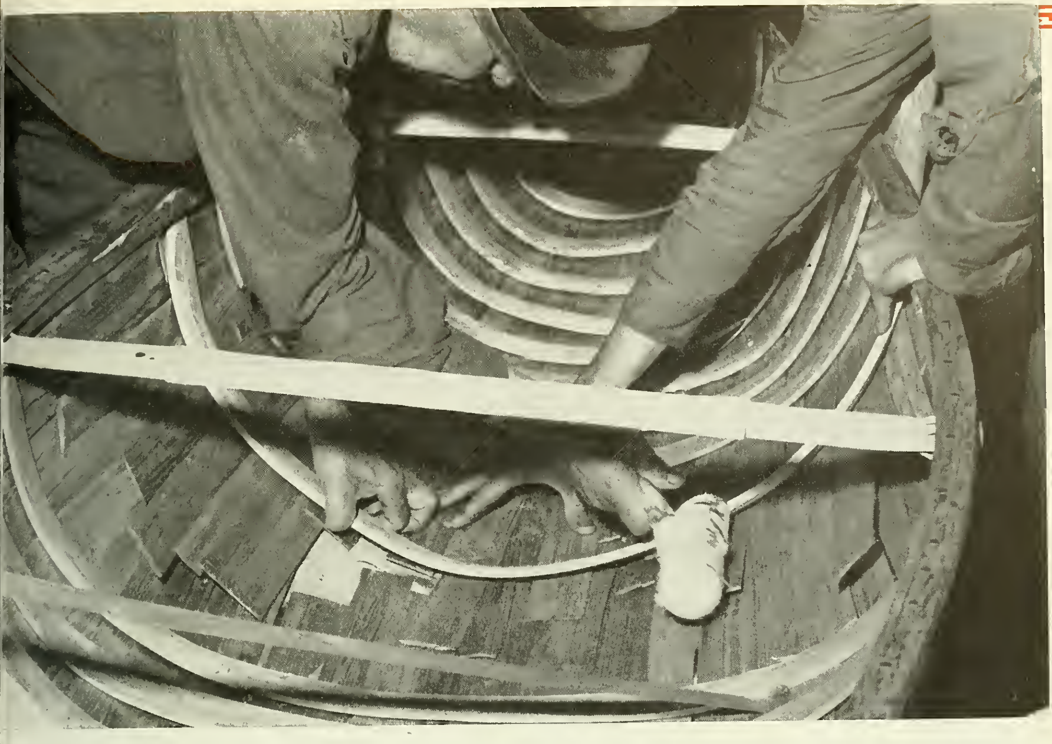


▲ TWO AT A TIME, the ribs are soaked and steamed to make them flexible enough for bending. Prior to this they have been shaped and smoothed with the Indian's indispensable "crooked knife." This has a five-inch blade, curved at the tip, which is set in a heavy handle. It is pulled toward the user like a one-handled drawknife. The Indian often makes it himself from an old file.

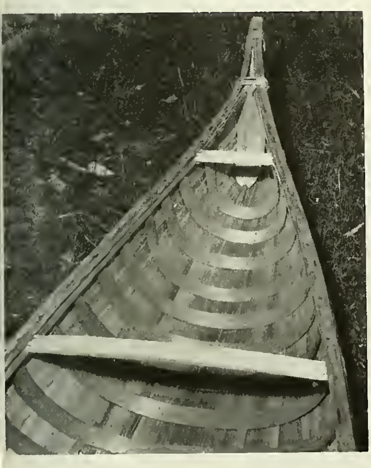
▲ STILL POWERFUL at 82, Dan puts his back into the task of bending ribs to the required curvature. For 40 years he has come each summer to the little Adirondack village where he makes and sells baskets and birch handicraft. He is widely known by visitors who spend their vacations in the Saranac region.



▲ THE BENT RIBS, still damp, are forced into the canoe over temporary sheathing strips, where they will be allowed to dry in the proper shape. Note the shavings that have been packed into the prow to stiffen the bark, following age-old custom. The ends of a bark canoe, beyond the ribs, are structurally the weakest parts.

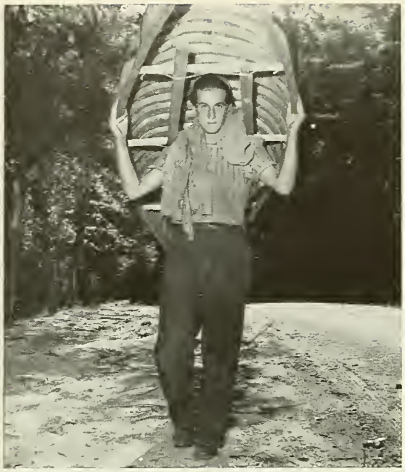


▲ AFTER DRYING, the ribs are removed so that permanent sheathing strips can be laid in position. Dan sets the latter shiplap style, lower over upper, "to make it easier to dump water out of the canoe." Here, Dan and his helper are replacing the ribs and inserting the ends in notches in the inner gunwales.



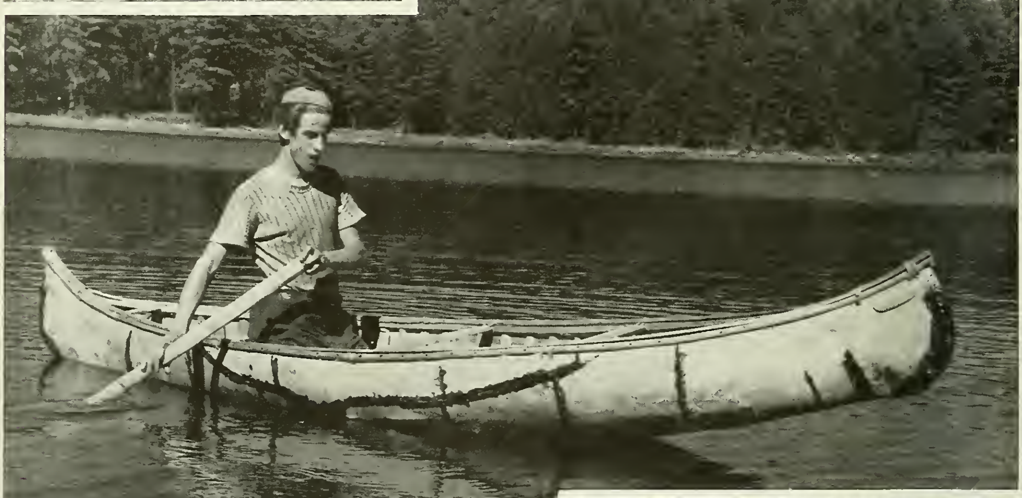
▲ AIDED BY SHRINKING of the bark, the ribs now exert strong pressure against the hull, making it quite rigid. Oval board stiffeners are placed in the ends.

▲ THE SEAMS are "pitched" with hot rosin. The rosin is made pliable with grease and darkened with charcoal so it will hide the lacings better. Dan's helper stands ready with a strip of re-enforcing cloth. Dan will smooth the cooling pitch carefully with a wet thumb.

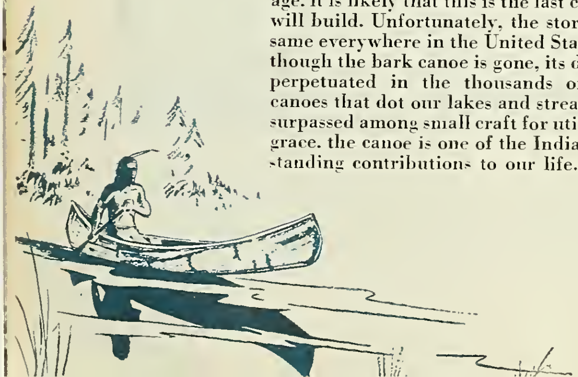


◂ Construction complete. Paul, the helper, hoists the 36-pound canoe portage-style and carries it to the lake to test it for leaks and riding quality. It is claimed that 15-foot canoes, easily carried by one man, were often used to transport an Indian family of several persons, plus their duffel and dogs.

▾ On the lake, Paul watches for leaks as he wields his makeshift paddle carefully to avoid tipping the light craft. Each end is decked over with small pieces of bark, which project in flaps visible in the photograph. These decks strengthen the junction of the gunwales. Larger flaps were sometimes left to keep water from splashing in. A canoe like this would take two men a fortnight to build if women did the sewing. A good one might last several seasons, but often a new canoe was built each year.



▸ The canoe is carried back to camp for pitching of a small leak. Considering Dan's age, it is likely that this is the last canoe he will build. Unfortunately, the story is the same everywhere in the United States. But though the bark canoe is gone, its design is perpetuated in the thousands of cedar canoes that dot our lakes and streams. Unsurpassed among small craft for utility and grace, the canoe is one of the Indian's outstanding contributions to our life.



◄ An enlarged view (10 times) of an adult male screw-worm fly (*Callitroga hominivorax*).

▼ A similar enlargement of full-grown screw-worm larvae. These are the parasites that infest warm-blooded creatures in southern climates.

fly-fighting with COBALT-60

Scientists produce impotent male flies in a campaign against the screw-worm—scourge of southern livestock

By Richard Bland McQuiston Mitchell

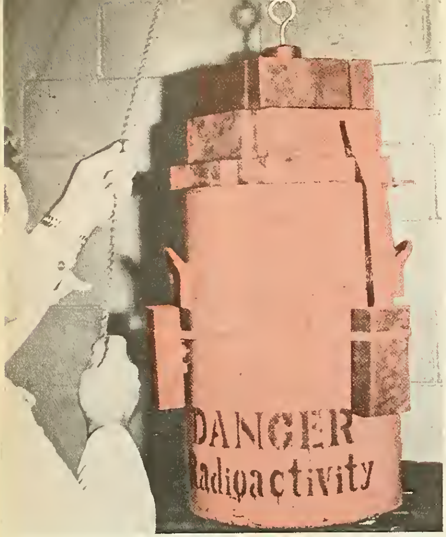
All photographs by Caribbean Photo Studio

As THE result of a unique experiment now being carried on by the U. S. Department of Agriculture, a new weapon may be developed to aid man in his never-ending war against insects.

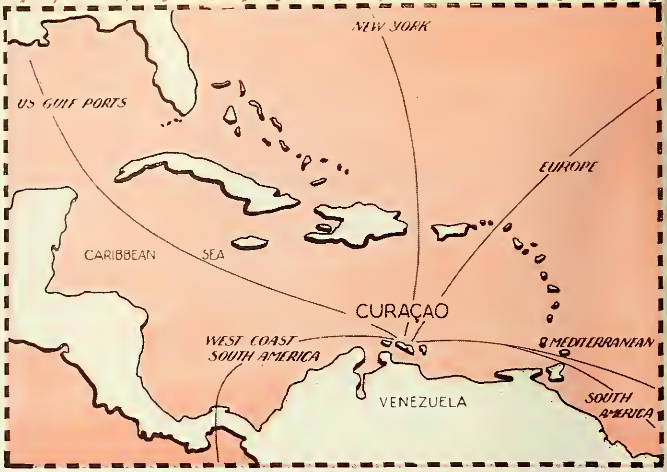
Since March, 1954, the small (170 square miles) island of Curaçao, in the Netherlands Antilles, has been the scene of a test to determine whether a particular species of insect pest can be completely eradicated in a given area — not merely controlled (which would mean a small percentage would be left alive) but exterminated down to the last individual.

The insect involved is the screw-worm fly, and the weapon which promises its eradication is a by-product of the atomic age—a radioactive isotope of cobalt known as cobalt-60. The experiment is being carried on by Department of Agriculture scientists with full cooperation of the Netherlands Antilles government.

Screw-worms are parasites on all warm-blooded animals, including man. The larval worms breed in any open wound. The nauseous smell caused by the first few parasites soon attracts others; and if left untreated, the unlucky host is eventually eaten alive by thousands of worms. Losses of livestock due to the screw-worm total about 20



▲ THIS IRRADIATION chamber contains cobalt-60, the radioactive isotope used to sterilize the adult male flies.



▲ THE TEST-SITE for the irradiation experiment is the Caribbean island of Curaçao, chosen because of its small size (170 square miles) and relative isolation.

million dollars a year in southern United States.

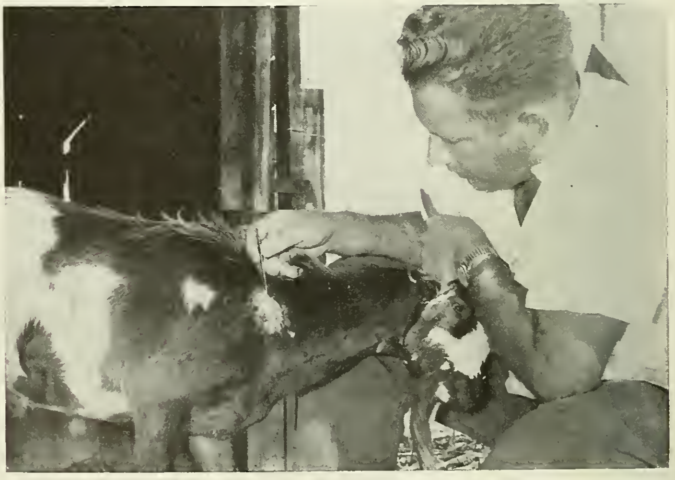
This parasite is found in most tropical and sub-tropical areas in the Americas, but in Florida the screw-worm was not introduced until 1933, when large numbers of cattle and other livestock were brought in from Texas. The fact that screw-worms were not present in Florida before indicated that if they could be exterminated in that state, the area could then be protected from re-infestation by a strict quarantine on incoming livestock.

Excellent treatments for worms in individual animals have been available for years, but eradication of screw-worms by this method was not practical because the parasites are carried by wildlife as well as by domestic livestock, thus providing continuous new sources for infestation. Prospects for complete extermination had to wait until Dr. E. F. Knipling, Chief of the Entomology Research Branch, proposed that screw-worms might be eradicated from the southeastern United States by releasing sterilized adult male flies. Following his suggestions, Dr. R. C Bushland began a series of tests in the Kerrville, Texas, laboratory. Dr. Bushland discovered that exposing the pupae of the parasite to gamma rays or X-rays caused sterility in adult flies. Screw-worm eggs resulting from a mating of these irradiated sterile flies did not hatch out into the larval worms that attack livestock.

This method of extermination adapted itself particularly to the screw-worm fly because, in the first place, this fly is not particularly abundant, as compared, for instance, with the house fly or mosquito. (The adult is hardly ever seen except when feeding or laying eggs on wounded animals.) In addition the female fly mates only once in her lifetime, and if she mates with a sterilized male, her ability to lay eggs that will hatch into worms is forever destroyed.

In contrast to many other insects, the screw-worm can easily be reared in large numbers in the laboratory,

▼ ENTOMOLOGIST BAUMHOVER examines a screw-worm laceration on a goat.



▲ Adult flies emerge from their pupal cases during the 30-hour flight from Florida to Curaçao.

▲ This view shows adult flies crawling about in the excelsiored interior of the specially designed sack.

since the life-cycle (21 days) is comparatively short. A readily obtainable culture-medium, consisting of ground-up meat mixed with blood, is used to rear the flies.

Therefore it was possible to obtain quickly hundreds of thousands of flies which later could be sterilized and broadcast over an infested area.

Laboratory tests of any new theory or process are always fine as far

▲ Curacao veterinary officer (center) receives shipment from Orlando, Fla.

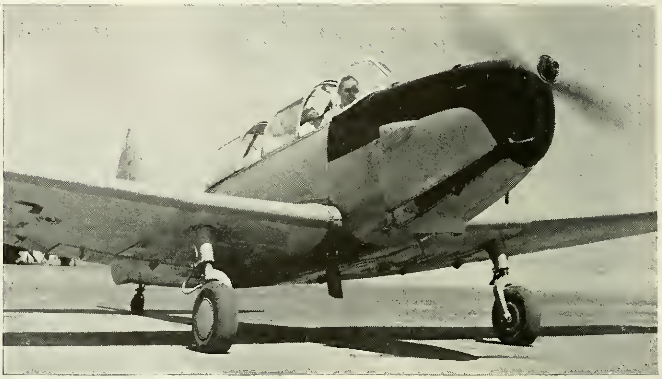
▼ The release sacks, compressed during shipment, are expanded to give the adult insects more room.

▼ Ballast for the air drop is applied with a cake decorator. The paste is a mixture of flour, sand, and water.

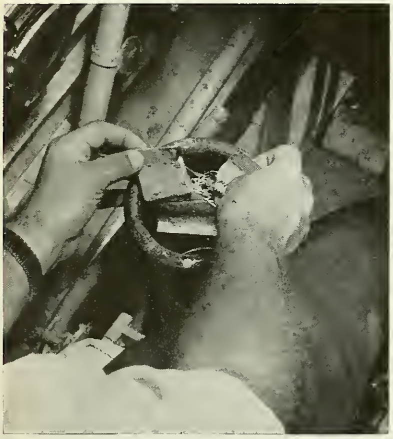
▼ A meat baster is used to feed honey through wire screens to sterilized flies.

▲ **BRIEFING** is given to ex-R.A.F. flier Mijs (right) by the entomologist before each fly-dropping mission.

as they go, but much more proof had to be obtained before this new approach could be tried out on a large scale. To undertake the dropping of millions of sterile flies over the entire state of Florida would have been prohibitively expensive. A small control area was needed where the expense would not be too high, and where there would not be a continual immigration of new flies. Preliminary field tests were carried out on the island of Sanibel near Ft. Myers, Florida, and results were encouraging, but this small island, lying only 2 miles off the coast, was neither isolated enough nor large enough for a conclusive test. Finally, the island of Curaçao, whose government officials had previously requested advice about their screw-worm problem, was selected as the site for an intensive test. It was planned that

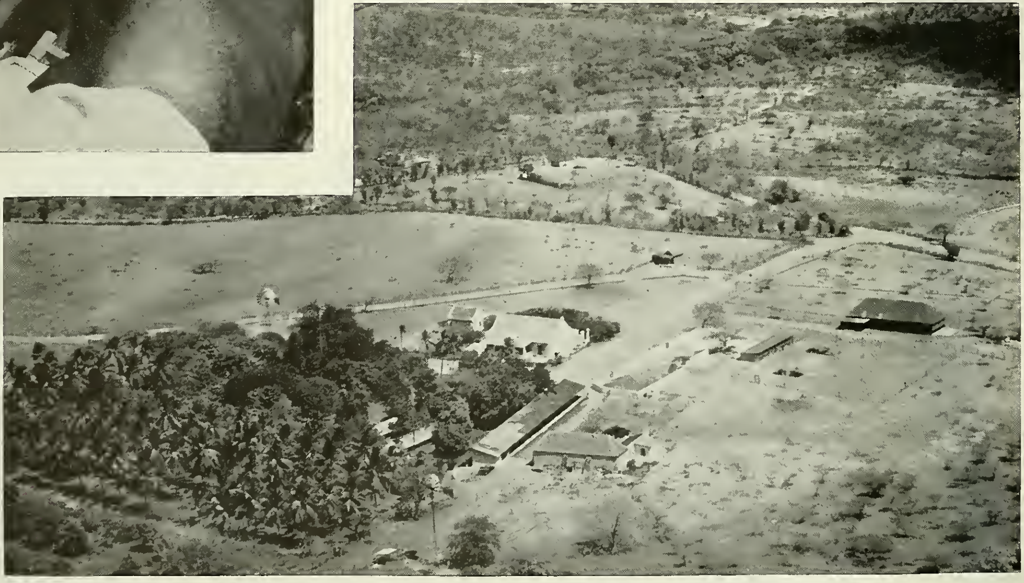


▲ **FLY-FIGHTER** taxis for take-off, armed with bags of buzzing, impotent flies.



◀ **ENTOMOLOGIST** (in rear seat) becomes bombardier, as he tears the sacks and slides them down a tube.

▼ **A VIEW** of part of the drop-area shows one of the plantations where goat pens were set up for testing.



if the experiment were successful here, there would be sufficient grounds for an extermination campaign in Florida. In the spring of 1954, A. H. Baumhover, a medical entomologist, and W. D. New, biological aid, were sent to Curaçao by the Department of Agriculture to begin the project.

Flies released over Curaçao are reared in the U. S. Department of Agriculture's Entomology Research Branch Laboratory at Orlando, Florida. On the fifth day of pupal development (seven days are required at 80° F. for emergence of adults) the flies are subjected to 30 minutes' irradiation in the cobalt-60 source built by the Atomic Energy Commission's Oak Ridge National Laboratory. This sterilizes both the males and the females. Although the females do not play an important part in this method of eradication they are released with the males because it is difficult to separate them. At present, the sexes can be identified only after the adults have emerged, and then only by looking at each one between the eyes.

Immediately after irradiation, approximately 130 pupae, which will produce 100 or more adult flies, are placed in each release sack (an ordinary kraft paper sack with a wire-screen bottom) for shipment by air-express to Curaçao. Shipping time is approximately 30 hours. Upon receipt in Curaçao the release sacks are extended to full size to increase the living space for emerging adult flies and then placed on an emergence table bottom side up. Before the flies are released from the air over the island, a paste of flour, sand, and water is applied to the sacks as ballast to avoid excessive drift by the wind. The wire-screen bottoms of the sacks allow feeding of the flies with honey before release.

After several months of experimental releases over Curaçao, a release-rate of 400 sterile male flies per square mile per week was settled upon. Shortly thereafter, the results were obvious. A sufficient number of the sterile males mated with female flies on the island to cause a high percentage of sterility in the egg masses collected each day, indicating that the breeding potential was being reduced tremendously.

In December, 1954, the screw-worms in Curaçao were actually reduced from a serious problem to a point where no livestock losses were reported in several weeks.

This does not mean that the screw-worm is forever extinct on the island; several months of further observation must pass before the extermination can be considered definite. However, the results do encourage the belief that an isolated population of screw-worms such as exists in Curaçao and in the southeastern United States can indeed be eradicated through the release of sterilized adult flies.

▲ As THE MISSIONS continue, the entomologist regularly samples the results. Here, egg masses are being removed from a screw-worm laceration for examination.

➤ A BINOCULAR MICROSCOPE is used to determine the percentage of infertile eggs in the sample. Final success will be achieved when no egg masses can be found.

▲ ETERNAL SOLITUDE is symbolized by this pond at the northern edge of the deep swamp. Its shores are lined with cypress, custard apple and pop ash trees, interlaced with flags and orchids.

The Natural Treasures of Big Cypress Swamp

Ancient cypresses, statuesque palms, majestic birds, and exotic orchids are preserved in a primeval setting of awesome beauty

By JEANNE VAN HOLMES

All photographs by Jack Holmes unless otherwise credited

BIG Cypress Swamp in southwest Florida is the largest swamp in the United States. It holds the world's greatest remaining stand of virgin bald cypress trees, the largest wood ibis and egret rookery in the United States, and our only natural forest of royal palms—a veritable treasure house of unspoiled beauty.

It was the interior of this swamp that my husband and I explored over a two-year period. We were drawn by the last wilderness stronghold of the ancient and magnificent bald cypress, which here in its southernmost range combines with lush tropical growth to make a unique watery wonderland.

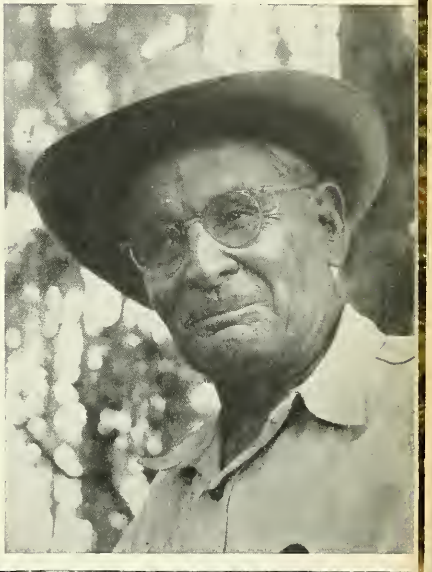
During the past year, in a dramatic conservation effort, a portion of Big Cypress Swamp known as "Corkscrew" was preserved for the American people and is now owned by the National Audubon Society.

When Jack and I first set out for this swamp, which lies to the west of the Everglades, we could not help but feel excited, for we were going into a region described on Indian War maps of less than a century ago as "UNEXAMINED." At dawn we left the boom town of Immokalee on Route 29 and headed west-southwest with Graham Whidden, an oldtime swampin' man. Fourteen miles of jeep travel over cattle and farming grades, hunting trails, and an invisible trace Graham had traveled some 50 years ago by oxcart, brought us to the edge of the swamp. We walked across the spongy prairie, bright with the pink, yellow, blue, purple, red, and white flowers that bloom so flamboyantly in Big Cypress, and then moved in among the bordering pond cypresses, which often grow no higher than a man's head.

Red-shouldered hawks flew close by us without fear, and we could hear the cries of the big wading birds—wood ibises, American and snowy egrets, limpkins and herons. As we worked our way in, the clear, brown water became deeper, the cypress trees taller and larger. Soon in the cool shade we were surrounded by luxuriant growths of arrowhead, trailing vines, ferns, and lilies. We were heading toward a group of the centuries-old, slow-grown cypress giants that thrive deep in the swamp.

Nearly a century ago, here in Big Cypress, 100 Mikasuki and Seminole Indians eluded 4000 soldiers with the help of this jungle. The warriors lured the soldiers on; then lay quietly in broad flat cypress crowns as their pursuers followed false trails below. Against limitless supplies of ammunition, the Indians had only five kegs of powder, but they decoyed groups of their enemy into open ponds, fired on them, and then vanished behind the trees.

The soldiers damned the Indians and damned the cypress swamp. Some on long duty in this unknown land of hellish names believed the water was poison because it flowed through Okaloacoochee, "bad bog, full of snakes," and lay sluggish in Coontee-sassa-hollober, "place of the black drink." Army flankers—alone in the shadows where every cypress looked like every other and every cypress might conceal an Indian — often became panicky. Their three-musket-shot distress signals sounded repeatedly over the swamp. It was said that Big Cypress itself killed some of the men, and the report went in to Washington: "Died incident to climate and service in Florida." The soldiers weighted their dead, strode into water up to their armpits, and sank the bodies in flag ponds. In the end, the soldiers went home and the Indians remained.



➤ GRAHAM WHIDDEN, eldest of five brothers who grew up in the swamp, has probed the mysteries of Big Cypress for more than 50 years.

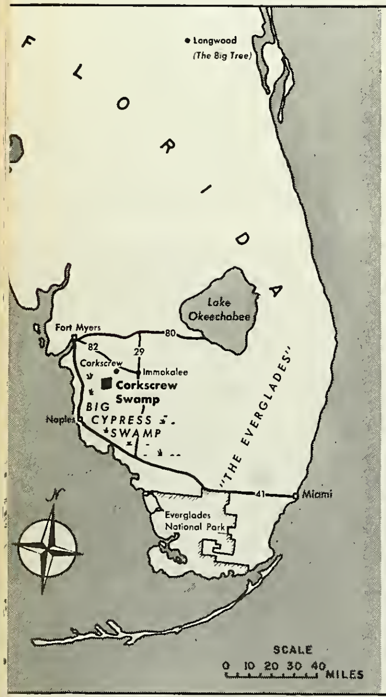
▼ ESCORTED by veteran swampsters Sam and Graham Whidden, the author and her husband wade through the hidden water of a lettuce lake.

The interior of Big Cypress Swamp lay forgotten by white men—except for missionaries, hide-and-feather hunters, cypress timber-cruisers, and a few pioneer families like the Whiddens—until 1943, when Lee Tidewater Cypress Company's loggers started cutting trees some 40 miles south of Corkscrew Swamp and began working their arduous, adventurous way north.

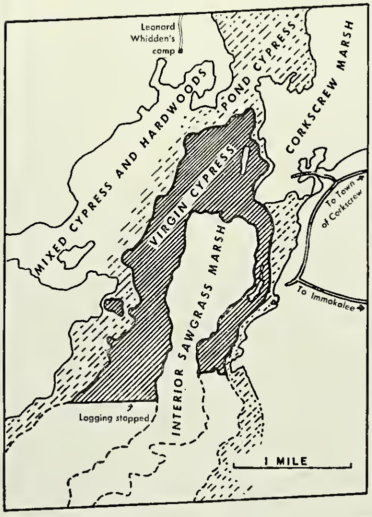
The big cypress trees Jack and I approached that day in Corkscrew will remain standing there for generations to come. It is a moving, extremely personal experience to come into the presence of these legendary giants. From wide-flared buttresses, velvet with moss, draped in fern and flower, the clean trunks rise more than a hundred feet into widespreading crowns of heavy limbs and delicate, light-green leaves. Close by the cypresses, which so far have thickened to six- and eight-foot diameters in Corkscrew, strangler-fig cords stretch from sunlight to water. Swallow-tailed kites swoop and drift low among the trees. Ghost orchids lie flat on the weathered gray bark. Among the arrowhead blades and ferns, hundreds of swamp lilies blossom white and purple. A flat sea of duckweed gives the swamp a shimmering green beauty.

William Strachey in 1610 named these trees "cypress" because he thought them similar in appearance to the true cypress genus, *Cupressus*. Though bald cypresses stand in treacherous footing, they are probably the most wind-firm of all trees; the hurricanes of Florida may tear the tops off a few very old ones, but they seldom blow a cypress flat. A wide-spread root system gives extra support by thrusting strange, cone-shaped stiffeners called cypress "knees" four or five feet into the air. In Big Cypress the knees seem to pop up everywhere. No one could guess to which tree they belong.

When we first waded into the swamp, I was wary of the venomous cottonmouth moccasins and rattlesnakes we would find there, but I soon saw that they, like the harmless indigos and water snakes, avoided us. We learned that in 10 years of logging not one of the 200 cypress loggers had been bitten. Even so, Jack couldn't believe his eyes one day as he stood laden with heavy camera gear, waist deep in a lettuce lake, and saw about 20 small black heads pop up around him. He was in no shape to prance around among 20 cottonmouths, and was immensely relieved to discover they were only baby alligators.



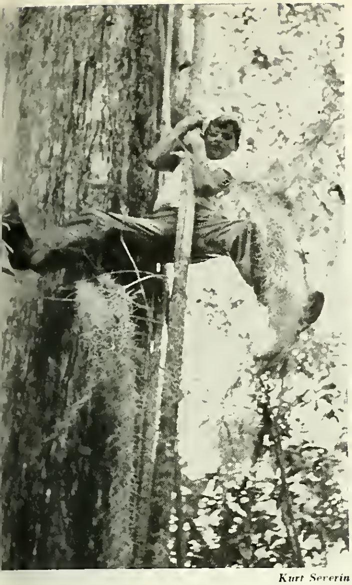
The map below, prepared by the author and her husband, is an enlargement of the rectangle labeled "Corkscrew Swamp" on the map of Florida at left. The author advises those who would like to visit the swamp to start at the town of Corkscrew and inquire for directions to the Whiddens or "Dutch" Bailey.



In the winter months the cypress, the only leaf-shedding conifer besides the larch, stands "bald," gray, and ghostlike. It is then that the nesting season is on. High in the crowns are an estimated ten thousand nests, for Corkscrew Swamp, locally called Bird Rookery Swamp, has long been a favorite place for wood ibises and egrets to rear their young. All through the horseshoe-shaped stand of trees, branches are white with birds. If you sit on a fallen log under the nests, built perhaps six or eight to a limb, you are deafened by the raucous cries of the young—and quite likely to have a dead fish dropped on your head. Below the well-inhabited trees we found islands of fallen nest-twigs that had built up two and three feet from the bottom over the years.

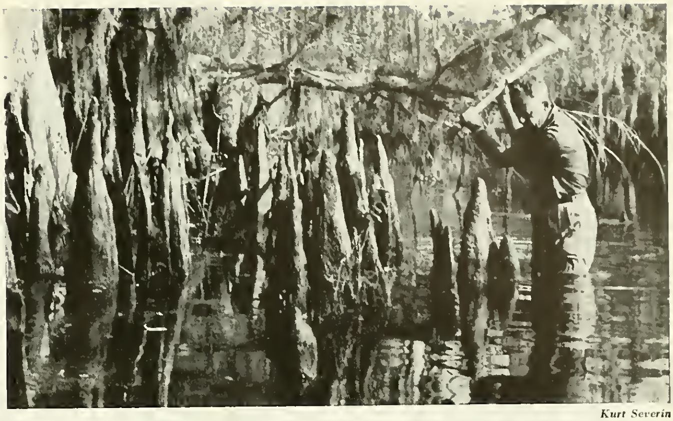
Under one wood ibis rookery, over in the less accessible west side of the "horseshoe," we found a three-foot "baby" wood ibis that had fallen from its nest. Still unable to fly, it walked up pompously and inspected our friend, Chester Walker. We watched the adult ibises with constant delight. Though gangly and ludicrous at rest, they abruptly took on streamlined grace and majesty as they spread their wings in flight.

One of the enchantments of Corkscrew is change. Walk a hundred feet in almost any direction and you will see a different kind of natural arena. Leonard Whidden, whose body is now half-paralyzed, keeps on going into the swamp and maintains a camp at its northern edge. "A person just can't get tired of it," he told us. "Even a lifetime won't let you see it all." The more time we spent there, the



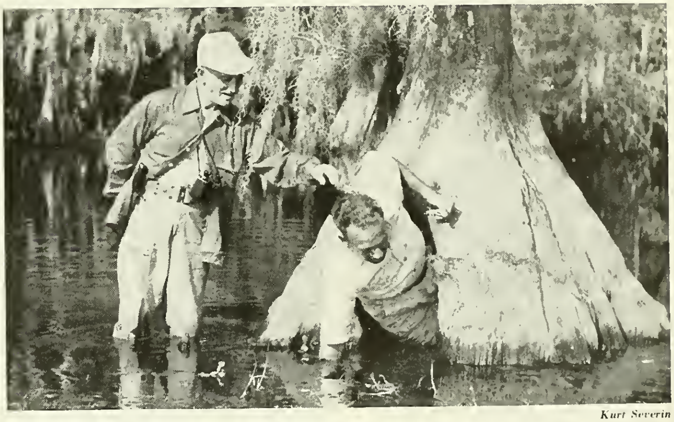
Kurt Severin

▲ **Boys will be boys**, especially in Big Cypress Swamp. This energetic 12-year-old hangs from a strangler fig that is attached to the crown of an 800-year-old cypress tree.



Kurt Severin

▲ Cypress "knees" are thrust up out of the water by wide-spreading roots.



Kurt Severin

▲ Swollen bases of cypress trees are often hollowed out by fungus "peck."

▼ Botanist Roy Woodbury grips a large but harmless indigo snake (also called gopher snake) captured in Fahkahatchee Strand.

more we realized how right he was, for there are the marshes, the lakes with their magnificent vistas, the "runs," the alligator holes and main alligator trails, and the pop ash and custard-apple ponds where orchids grow thickest. Of the 69 orchids native to south Florida, more than 30 have been found so far in Big Cypress. Of the six which are native only to Big Cypress, the pale yellow summertime bloom of the vanilla orchid is one of the loveliest, but at every time of the year you can find orchids blooming.

We found cypresses joined by natural graft, cypresses hollowed by fungus "peck," five big cypresses standing in a regimental line—old windblown trees, vigorous young timber, and brand-new seedlings. If your legs are strong, you can see here in almost every phase of life the legendary and ancient cypress.

Fifty million years ago cypress forests spread a canopy over the last of the dinosaurs; 30 million years ago they flourished all over

Allan D. Cruikshank from National Audubon Society

▲ **Wood ibises** are grotesque at rest, but become breathtakingly majestic in flight. Actually, they are storks, the only members of this large and legendary family native to North America.

▼ **Chester Walker** of Corkscrew is wary of this young wood ibis which has fallen from its nest. Local residents call this bird "ironhead" and "flinthead," which explains Chester's caution.

the northern hemisphere and were America's most abundant trees. The bald cypress, *Taxodium distichum,* is first cousin to our native redwoods and the recently discovered dawn redwood of China. As the finicky redwoods retreated to slim strongholds on the Pacific coast and in China, the bald cypress retreated with the summer rains, winding up at last in the swamps of the south and east in a region now occupied by 18 of our states.

Though it is not wise to go into the interior of Big Cypress Swamp by yourself, I came close to bogging only once. Jack had gone a few hundred yards from me to take photographs, and I decided to follow. Both my legs suddenly sank deep into the muck without hitting anything solid. I looked around for a cypress knee or pickerel weed — anything to clutch — then panicked when I found nothing. Foolishly, I started pumping my legs. I was scared and the muck seemed to pull at my body. I'd done a pretty good job of sinking myself before I regained my sanity, gave the long-carrying call I had learned from the loggers, and stayed motionless until Jack came and fished me out.

The most treacherous place in the swamp is Lake of the Tussocks on the east side of Corkscrew. Jack and I set out across the tussocks (small floating islands) to get pictures of the wild hibiscus, an herbaceous, ten-foot perennial, whose scarlet petals shine vividly against the gray backdrop of cypress bark and Spanish moss. (Though we did not know it, we were establishing this flower's southernmost record; hitherto, it had been unknown here to botanists.) Some of the tussocks were strong enough to hold our combined weight; others, to put it simply, were not. As Graham Whidden says, "With a tussock you can choose. You can step off it or go down with it."

The hardest part of Big Cypress to get through is logged-over Fahkahatchee Strand, which once was similar to the preserved area in Corkscrew. In 1945 Richard Archbold, Leonard J. Brass, and others collected specimens in this strand for the Florida Black Bear Group of the American Museum of Natural History. They gathered many items, but found bear so elusive here that they finally caught them farther north. It has been said a black snake could scarcely wriggle through Fahkahatchee, and when we set out one sunrise with Roy Woodbury of the University of Miami Botany Department and four other botanists, I quickly discovered why. Though Lee Cypress Company does an outstandingly neat job of logging, leaving trees standing wherever possible, the swamp was littered with logs, logging trash, and huge cypress crowns. Fire after fire had flamed through this tinder box, killing off the thin-barked cypress seedlings. Once the shading canopy of cypress trees was gone, tough and scrubby willow had sprung up.

After several miles of stepping over jackstraw piles of logs resting in three or four feet of water, my leg muscles were getting painfully sore, but feminine pride wouldn't let me slow the men down, and we had a long way to go. I was extremely curious about this section, for I had heard from an unreliable source of an old cypress stump more than 15 feet across at head height. This was not impossible, for cypress trees nearly that big had been cut out of north and central Florida in the early 1900's, and the bald cypress is brother to Mexico's *Taxodium mucronatum,* a noncommercial species famed for spawning the thickest tree in the world (greatest diameter 52 feet) in the tiny village of Tule. But my stump did not materialize.

We circled around clusters of the Paurotis palm, around cypress stumps verdant with sprouts and strap ferns, and clambered over ridges of logging railroad spurs now grown up in weed and flower. Botanist Woodbury moved fast, always on the lookout for the rare and the undiscovered, for as recently as 1947 he discovered in Big Cypress two plants hitherto unknown in this country: the *Peperomia alata,* with its attractive yellow-green foliage, and the *Tillandsia pruinosa,* a silvery air-plant less than four inches tall. And here was found *Lycopodium dichotomum,* one of the most primitive of land plants and the only epiphytic lycopodium in the United States.

By the time we finally reached the royal palm forest, where the slender white boles rise 150 feet toward the sky, my leg-lifting muscles were completely worn out. I had to wonder over the feat of the Hialeah Race Course men who came here in the early 1930's with Model A trucks over a homemade "floating" roadbed. They had blasted out of this same quivering area the 200 royal palms which, swamp-marked by moss and lichen, now line Hialeah's Club House Drive.

We had to keep moving to get out of the swamp by dark. I made my legs work by pushing and pulling at them to get them over logs. Roy told me the same "cypress swamp" leg fatigue had plagued him in Okefenokee. We made fre-

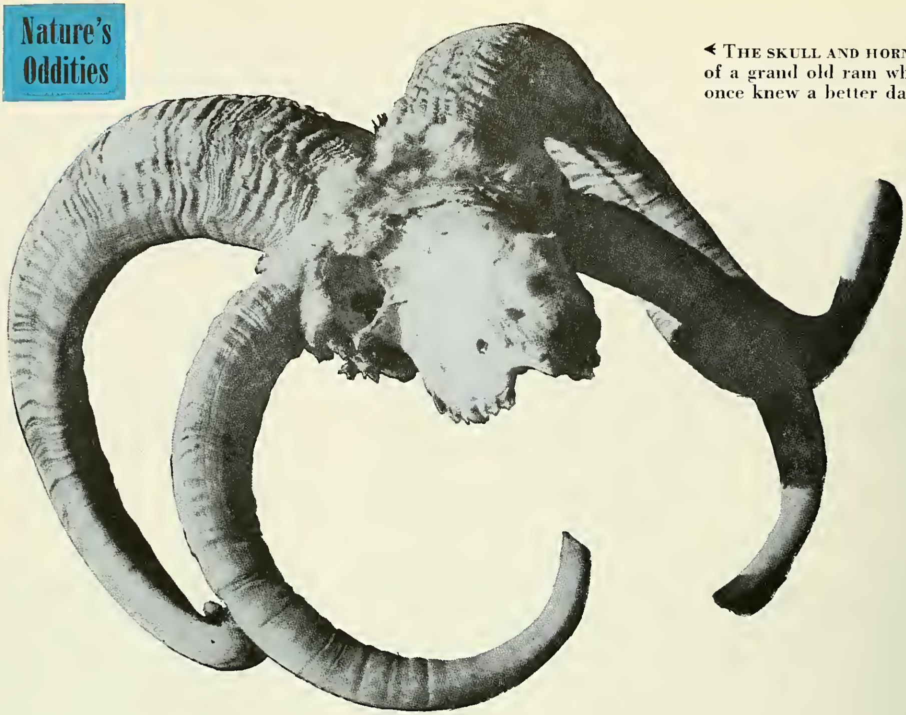
continued on page 280

▲ **The wild hibiscus** has a showy scarlet blossom. This 10-foot plant had been unreported so far south until the author and her husband found it in Corkscrew Swamp.

▲ **Jim Davis,** "skidder boss" of Lee Tidewater Cypress Company, examines a girdled cypress, which, with its eight-foot diameter, is about as big as they grow in Corkscrew Swamp. The trees are girdled before felling to rid them of their enormous water content.

➤ **Engine Number One,** a "cabbage-head" locomotive, has been performing yeoman duty for cypress loggers since the early 1900's.

Nature's Oddities



◄ THE SKULL AND HORNS of a grand old ram who once knew a better day.

Four-Horned RAMS

Navajo sheepherders rear strange beasts in the arid wastelands of the Southwest

By RALPH D. CORNELL

All Photographs by the Author

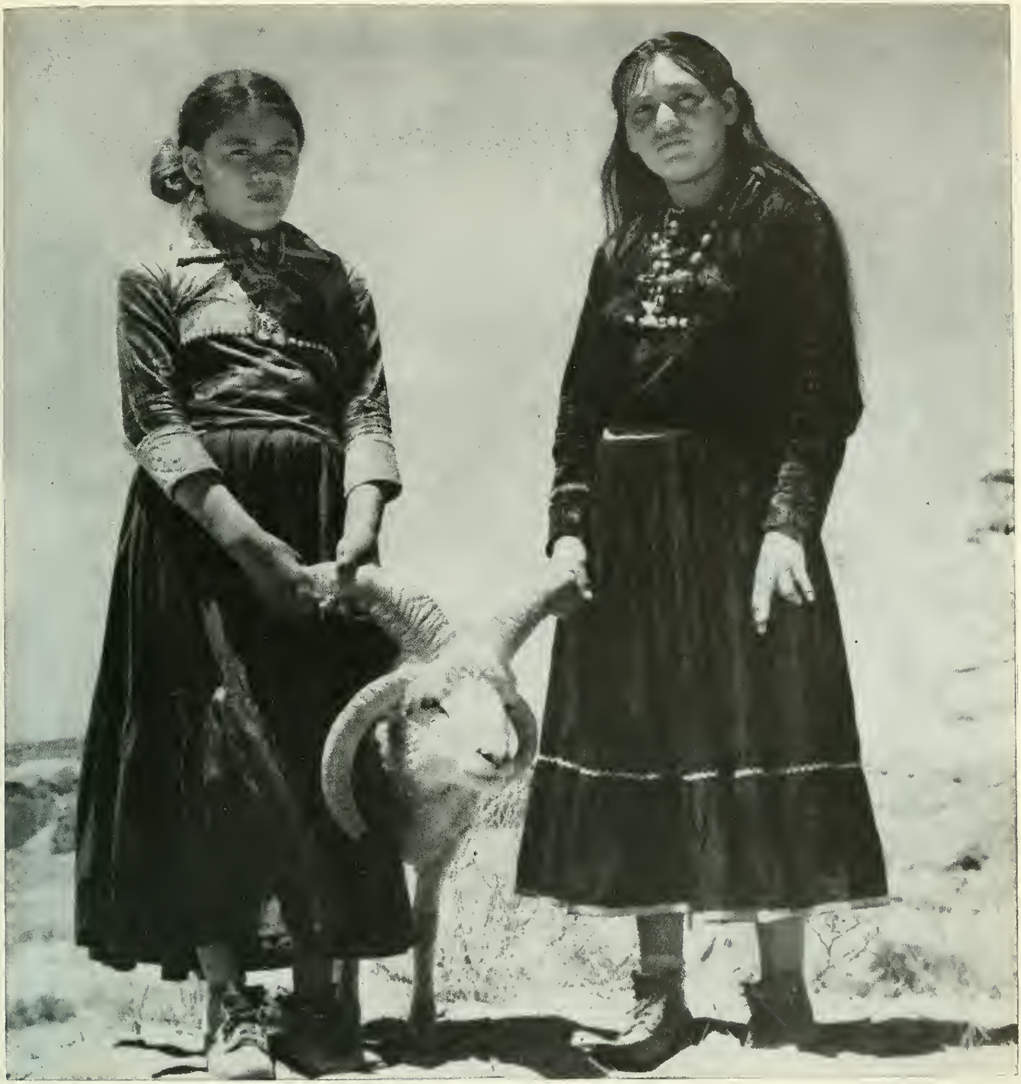
THE first time I saw a four-horned ram was on a hot June day in northern Arizona, deep in Navajoland. I had not known that such an animal existed.

Harry Goulding, celebrated Indian trader, had told me that the Navajos would be gathering with their sheep at a windmill tank down the road. We had seen the flocks coming in from distant parts of the desert, their movement telegraphed by small dust clouds. Perhaps it would be worth a look.

As the flock arrived, the sheep were halted and held at a distance from the tank where they were to be dipped in disinfectant. The Navajos set up their encampment, and little fires sprang up amid the typical activities of a band of nomadic herders. Since I was a dude enjoying his first experience with the Navajo, I watched them intently.

And then I saw this curious animal. The ram was lying on the ground with its neck outstretched, its four horns pointing awkwardly in different directions.

Back at the Monument Valley Trading Post, Harry Goulding had told me that four-horned rams were not uncommon in the Navajo herds, particularly those in remote sections. These sheep have been isolated from outside blood for many years—in fact, ever since the Navajo people first withdrew from civilization into the little-known vastness of the Southwest. I learned, however, that there are several breeds of four-horned sheep, some from China, some from Iceland, and others from South Africa. Reginald I. Pocock, former head of the London Zoological Society gardens, described the four-horned sheep as a domesticated breed in which each horn is split in two, its division being in the basic core and not externally.



▲ **Bored Navajo maidens** pose with an equally bored ram whose head has four handles by which he can be coaxed into position.

Four-horned sheep are common enough for the Navajos to accept them without excitement. Even if the owner of such a ram looks upon the animal with special respect, it is not sufficient to provide "diplomatic immunity." I have seen four-horned rams bartered to a trader for flour, coffee, and sugar.

The upper set of horns frequently develop to greater size and closer symmetry than the lower pair. These show less vigor and are inclined to be deformed. But as in all life, there is the occasional instance where real perfection is approached.

The finest set of four horns came to my attention only after the sturdy ram who bore them had completed his span of life. They had been found by a little Indian girl, who came into the trading post in the spring. In the winter, she had hidden the horns in the rocks where they would be safe until she could make the journey, for she knew that the trader had always admired the ram who carried them. As you can judge from the photograph reproduced with this article, it was no easy task for her to carry the skull of this old ram with its four symmetrical horns.

The Age o

American Petroleum Institute

▲ A ROTARY DRILL is readied for its journey deep into the earth.

This article was partly adapted from the newly opened
Hall of Oil Geology at the American Museum of Natural History

PETROLEUM

How a curious fluid that seeped from the rocks has quickened the pulse of civilization

By William Barry Furlong

AGAINST the massive backdrop of geological history, the Age of Petroleum may be called a mere moment in time. It flickered into life in the middle of the 19th century and flared into brilliant maturity before the 20th century was one-quarter exhausted.

The Atomic Age may usher in undreamed-of developments, but no period in the long history of man has seen more changes than the Age of Petroleum. During petroleum's uncontested reign, the civilized world underwent a series of mammoth convulsions – in its physical life, political life, and economic life – that have made the Age of Petroleum an epoch of romance, of revolution, of intense conflict between man and nature and man and himself. Whole armies have died to control oil fields. The economies of nations have been built on the shale of petroleum. An industrial revolution that burdens the imagination was made possible by petroleum.

No nation was more profoundly affected by all this than the United States. In 1850, machines performed six per cent of the heavy labor in the U.S.; a century later, machines performed 96 per cent. More than half the total energy now generated every year in this country, including that from coal, water, and human beings, is produced by petroleum. The weekly energy output of petroleum in the United States has been estimated to exceed 40 hours' work of 22 *billion* persons—ten times the total population of the world.

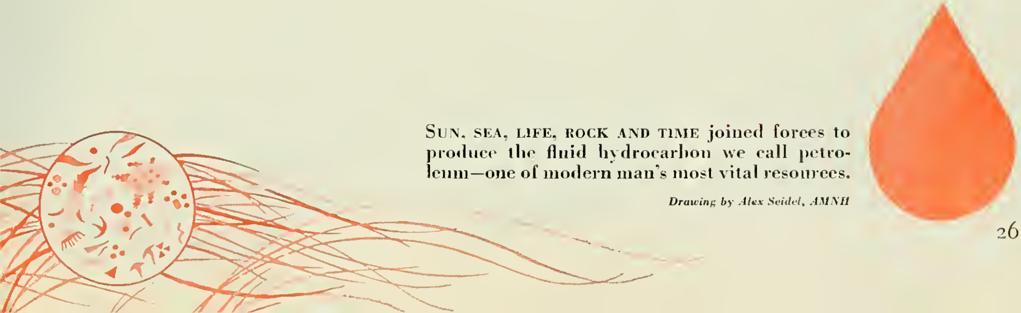
To the industrialist, this means that the U.S. can produce two to four times more goods with every man-hour of labor than the most highly industrialized countries of Europe.

To the farmer, this means that he can produce an acre of wheat in one-thirtieth the working time required a century ago.

To the average person, this means that petroleum has become as commonplace as air and just about as noticeable.

Last year, every American utilized, on the average, 739 gallons of petroleum; every Russian used perhaps 75 gallons, and every Chinese probably no more than 12 gallons. When the American appraises the benefits of petroleum, he thinks immediately of his automobile, and quite properly. About one-third of the total U.S. refinery capacity produces gasoline to make it go. It uses rubber tires, which demand petroleum in their manufacture, and travels on roads made of asphalt, another petroleum product. But there are other uses he may not know about. If the floors of his home or office are waxed or varnished, they have consumed petroleum. The inks that print his newspapers, magazines, and books consume petroleum. The plastics in his telephone or kitchenware consume petroleum. His hair tonic and rubbing alcohol, or *her* cold cream, perfume, and lipstick consume petroleum. The fibers of his clothes, if they are cotton or wool, are lubricated and cleaned by petroleum products; if they are synthetic, petroleum makes up a part of the synthesis. His leather shoes are treated with oil when they are manufactured. In almost every waking minute, he is in contact with a petroleum product or a product demanding petroleum in its manufacture.

The fact that our nation in a single week uses as much petroleum as one oil field can produce in 20 to 30 years has given the last generation of the Age of Petroleum an air of extraordinary energy. Supplies of natural petroleum are not inexhaustible and new sources are increasingly difficult to find and tap. But even though the 1954 rate of



Sun, sea, life, rock and time joined forces to produce the fluid hydrocarbon we call petroleum—one of modern man's most vital resources.

Drawing by Alex Seidel, AMNH

The Search for Oil

Oil geologists, who begin the investigations, collect samples of surface outcroppings, examine them to determine if they are marine

crude oil production would use up all known reserves in the U.S. in 13.1 years, there is still no cause for general alarm. The reason is the probable but still undiscovered reserves of the U.S. and of the world. It is upon these, and the ability to find them, that the oil industry bases its optimism. Last year, oil explorers not only discovered enough new deposits of crude oil in the U.S. to offset 1954 production but enough extra to raise the nation's known reserves by almost 616 million barrels.

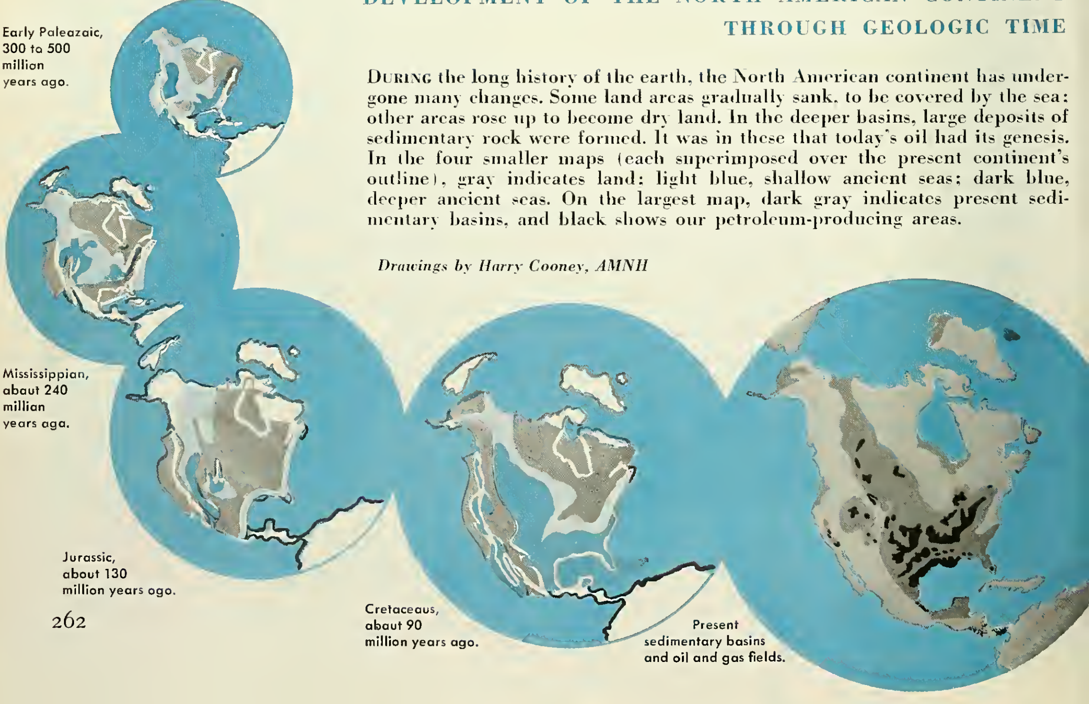
Consumption has long been the spur of discovery. In 1919 some geologists were convinced that only six billion barrels of oil remained below the nation's surface. Since then, about 11 times that amount has been discovered. In 1926, a committee of Cabinet members solemnly warned President Coolidge that the United States had only enough petroleum reserves to last six years. Since then, annual consumption has more than doubled and our known reserves have reached their highest point in history. And beyond our own boundaries, the other nations of the world harbor untold deposits of petroleum, while the sea covers great reserves just beginning to be tapped.

Thus far, crude oil or natural gas or both, have been produced in 30 states and more than 40 foreign countries. Saudi Arabia is the rich-

DEVELOPMENT OF THE NORTH AMERICAN CONTINENT THROUGH GEOLOGIC TIME

During the long history of the earth, the North American continent has undergone many changes. Some land areas gradually sank, to be covered by the sea; other areas rose up to become dry land. In the deeper basins, large deposits of sedimentary rock were formed. It was in these that today's oil had its genesis. In the four smaller maps (each superimposed over the present continent's outline), gray indicates land; light blue, shallow ancient seas; dark blue, deeper ancient seas. On the largest map, dark gray indicates present sedimentary basins, and black shows our petroleum-producing areas.

Drawings by Harry Cooney, AMNH


Early Paleozoic, 300 to 500 million years ago.
Mississippian, about 240 million years ago.
Jurassic, about 130 million years ago.
Cretaceous, about 90 million years ago.
Present sedimentary basins and oil and gas fields.

Standard Oil Company (New Jersey)

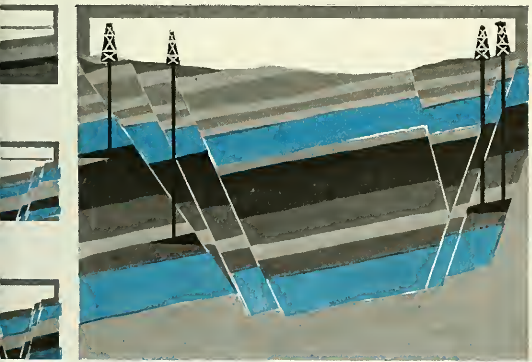
sedimentary rocks, and then, with the aid of instruments like the plane table, stadia rod, and Brunton compass, prepare maps showing the estimated extent of rocks that might hold scattered accumulations of petroleum.

est oil country in the world; it has known reserves of 30 billion barrels. The United States is second with 29.6 billion barrels, while the tiny nation of Kuwait (the size of Delaware) has some 20 billion. The Soviet Union is seventh, with 9.75 billion barrels—as far as is known. But if Russia could conquer or absorb as satellites the Arabian nations of the Middle East that sit invitingly close to her southwestern borders – Saudi Arabia, Kuwait, Iran, Iraq, Qatar—she could multiply her reserves by eight and move far out in front.

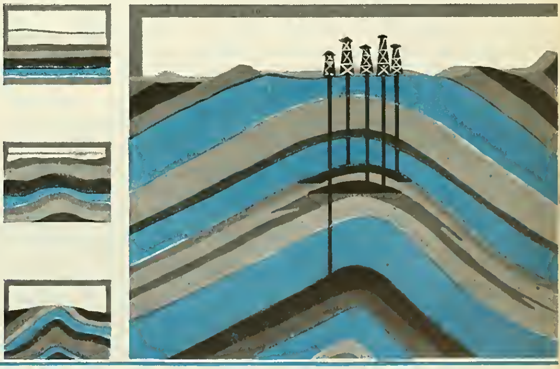
The never-ending battle to sustain our industry by finding more oil is one of the most urgent, intense, and least-known struggles of the present century. Its chief demand: persistence. In Bolivia, American oil companies explored 18,000 square miles of steaming jungle, slashed 1,000 miles of roads through the wilderness, and spent millions of dollars in 35 separate expeditions before discovering oil. In Alberta, Canada, 134 wells were drilled with a total depth of 160 miles in 30 years of exploration before oil was discovered. In east Texas, an aging wildcatter named "Dad" Joiner sank two dry wells to prove that oil existed in a location nobody thought possible. He drilled to 1,530 feet on his third one before running out of money. He chopped scrub pine on a farm near his well to get fuel for his boilers. He sold chunks of his lease—eight acres for $125—to meet payrolls. One scout for an oil company visited Joiner's lease 20 times without finding the well in operation. Not long after his 71st birthday, Joiner struck oil at 3,592 feet. Soon a four-acre tract of the lease was selling for $10,000. The area eventually became the largest known oil field in the United States.

Short of drilling, there is no way of determining certainly whether oil exists at any point under the earth's surface. But there are a great many clues as to where it *might* exist, and geologists spend

Fault oil-trap. Petroleum seeps through porous rock and accumulates in natural "traps." A fault trap is formed when the broken edge (or fault) of an oil-bearing layer comes into contact with a layer that is impervious to petroleum.



Anticline oil-trap. This type, the commonest of all, is an arch or fold of sedimentary rock in which the oil is trapped above and below layers of impervious shale. The oil always rests on top of water.



years searching for and exploiting these clues. Yet their ultimate success or failure must wait the probing of the drill. There are an estimated 1½ million square miles in the U.S. where oil *might* exist. But only one out of nine wells sunk by wildcatters—persons who seek oil outside areas of proven reserves—ever strikes oil, and only one out of 44 strikes a modest deposit of one million barrels.

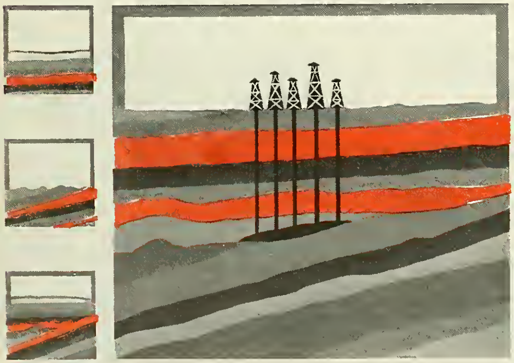
Through the years a number of highly specialized techniques have been developed in the endless groping for oil. Geologists perform an important service at the outset by determining with considerable accuracy where oil cannot possibly exist. This they do by outlining the extensive areas of marine sedimentary rock and excluding all the rest, for it is only in this type of rock—formed from sediments at the bottom of ancient seas—that sizable accumulations of petroleum are ever found. Their reconnaissance is followed up by skilled oil prospectors with seismographs, magnetometers, gravity meters, and electric and radioactivity logs, who find out if the sedimentary rock has thick porous layers that *might* hold good quantities of a fluid like oil, and if there are irregularities in these layers where oil *might* be trapped.

The techniques of searching for oil, along with an explanation of its origin and the methods of extracting it from the ground, are graphically presented in an exhibit which opened March 23 in the American Museum of Natural History. The exhibit, the result of more than a year of planning and building, was constructed in co-operation with Standard Oil Company (New Jersey). "In this hall we deal with inanimate nature as a provider for human existence," said Museum Director Albert E. Parr, at the opening. "This subject of oil geology also is related to our plans for a new anthropological exhibit section we think of as 'The Epic of America.' Petroleum is part of that epic."

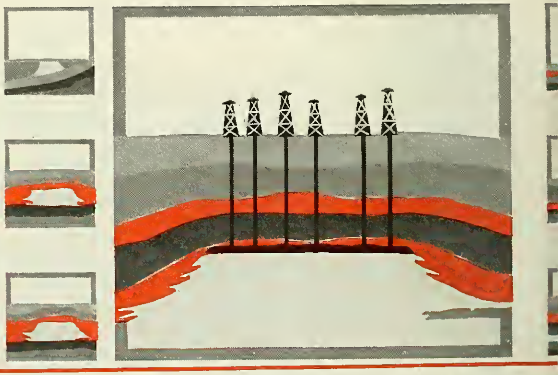
The genesis of petroleum's part in that epic and the gestation period for the Age of Petroleum were agonizingly slow. The oldest known oil deposits date back about 450 million years; the youngest about 10 million years. Where the oil came from has long been an intriguing puzzle for scientists. In the past it was believed that petroleum was inorganic in origin (its name comes from two Latin words: *petra*, meaning rock, and *oleum*, meaning oil). Now, leading geologists believe that petroleum came from living things—plants and animals in ancient seas. Just as coal has been called "fossilized sunlight" that fell on the land, petroleum has been called "fossilized sunlight" that fell on the sea. "Our reasoning is still somewhat deductive," says Dr. Norman D. Newell, Curator of Historical Geology at the Museum, "but it's anchored in careful observation."

The sea was probably the incubator of the organisms that turned into petroleum. Crude oil appears to consist of the partly decomposed remains of plants and animals that lived only in the sea. Even now the waters of the sea, where the nourishing energy of the sun's rays play, hold an incalculable amount of plant and animal life. "Life in the sea has

Seismic Prospec



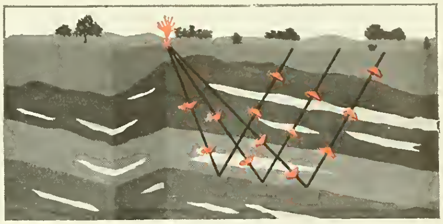
STRATIGRAPHIC OIL-TRAP. Occasionally, portions of the sea bottom were lifted up, tilted, and eroded. When again inundated, new sediments were deposited at an angle, forming traps for petroleum.



REEF OIL-TRAP. Many great oil fields lie in ancient, buried reefs. Originally, reefs were built up from the sea floor by tiny marine organisms. Later, they were buried under layers of rock to become mound-shaped oil reservoirs.

Standard Oil Company (New Jersey)

A SEISMOGRAPH CREW plants a charge of dynamite in a hole (left) and explodes it (above) to produce a miniature earthquake.



WAVES OF SOUND from the exploding dynamite travel through the earth in all directions. Hard layers send back "echoes," which are traced as a seismogram. Scientists can then interpret the tracings to determine the depth and slope of the reflecting layers of rock.

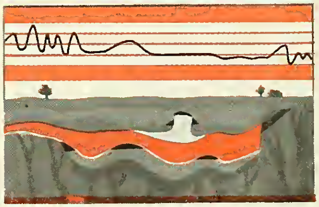
always been much richer than on the land," says Dr. Newell. "In fact, if all the life now found on land were dumped into the sea, the concentration of sea life would not be greatly changed."

As the countless billions of tiny sea creatures of ancient times died, they drifted to the bottom. These probably were mainly microscopic plants, which contain much fat and hardly any woody material as compared with the dominant land plants. But tiny animals, which lived on the plants, also added their remains. The enormous but gradual accumulations mingled with sand and mud and rock, and, after eons of time, became buried many thous-

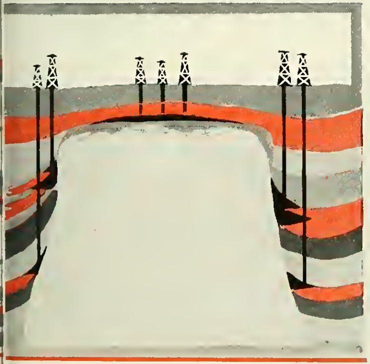
American Petroleum Institute

Magnetic Prospecting

THE AIRBORNE MAGNETOMETER facilitates quick surveys of vast areas by recording changes in the earth's magnetic force. Where this force is strong but erratic, oil prospects are slim; where it is weak and even, a thick layer of sedimentary rock can be assumed, warranting further search. Below: a sample tracing.

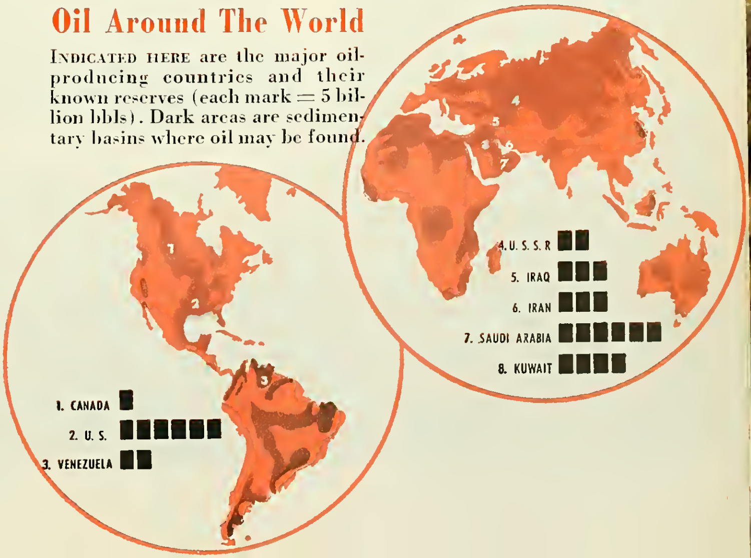


T DOME OIL-TRAP. Great quantities of ied salt became plastic under pressure l were squeezed upward into tall domes. ing non-porous, these created traps for oil.



Oil Around The World

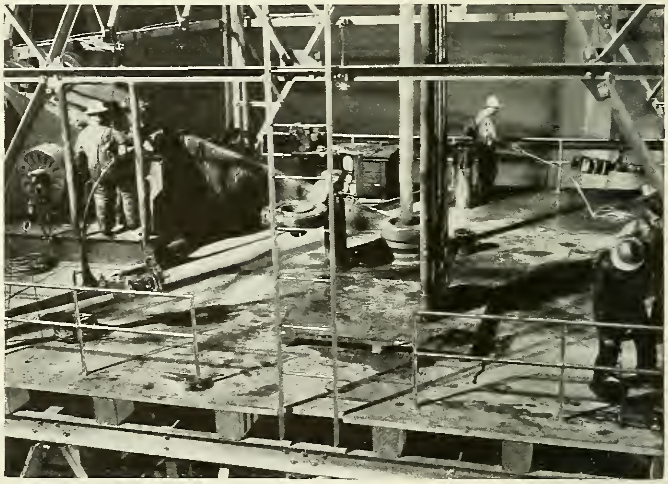
INDICATED HERE are the major oil-producing countries and their known reserves (each mark = 5 billion bbls). Dark areas are sedimentary basins where oil may be found.

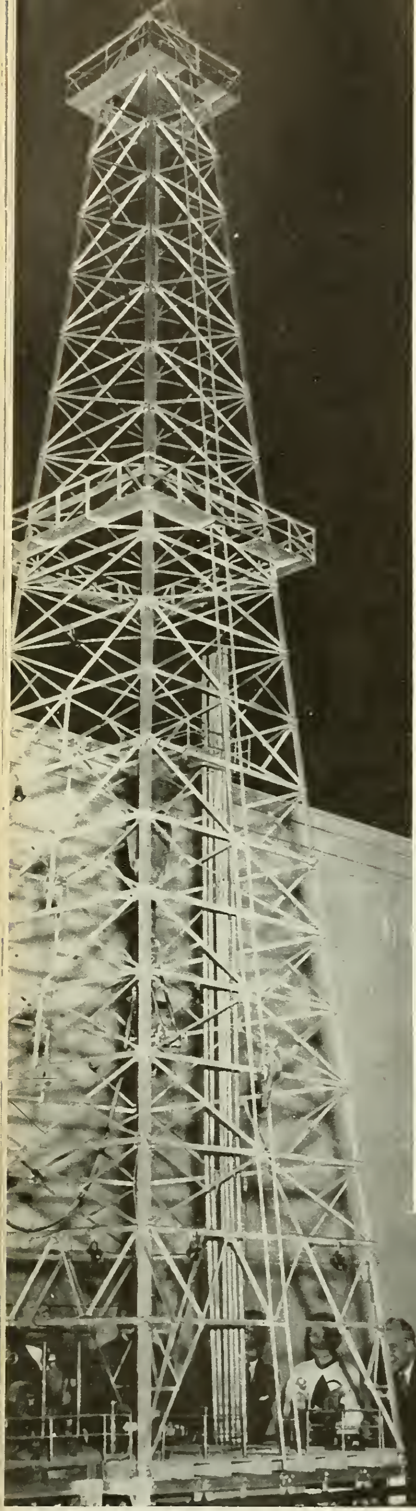


ands of feet below the earth's surface. Just how these plant and animal remains were changed into petroleum is still unknown. Scientists of the oil industry are trying to find out, and have discovered that the process is apparently still going on. "Some organic materials that are indistinguishable from the organic material in petroleum have been found in the Gulf of Mexico and off the coast of California," says Dr. Newell. But ages were required in the past for the conversion of these organic materials into petroleum, and scientists would like to duplicate the process. Some of them suspect that not one but several methods for synthesizing petroleum will be discovered.

During the formation of petroleum, and long afterwards, the seas and the earth were in continual change. The seas washed over large continental areas and later receded. The earth's crust yielded from time to time. Great mountain ranges were formed, then leveled millions of years later. During these many changes, deposits of oil were left beneath both land and sea. The petroleum itself was also in motion. (It does not flow in great subterranean lakes but is contained in the small pores of sandstone and limestone.) Under the enormous weight of land and sea above it, applied unevenly, the petroleum seeped through porous rock until it was blocked by layers or masses of relatively non-porous rock. Then, unable to go farther or to retreat, it became lodged against the nonporous rock and formed large accumulations. In some places it was caught in porous layers bent into shallow domes, like inverted bowls. In other places, the warping of the

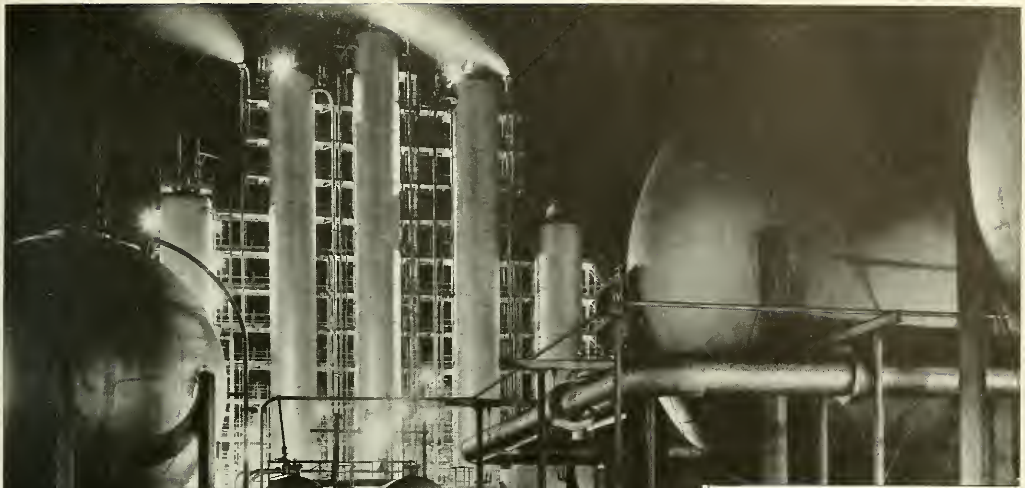
AMNH





Oil in the Museum

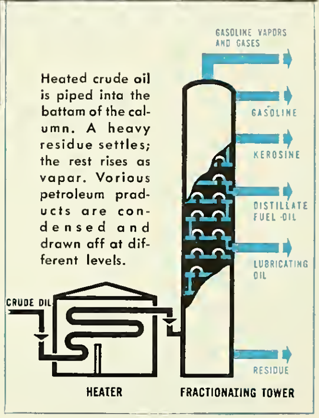
A 25-FOOT MODEL oil derrick stands in the center of the new Hall of Oil Geology at the Museum. Examining it are (left to right): Arthur T. Proudfit, Director of Standard Oil Company (New Jersey); Alexander M. White, Museum President, and Dr. Albert E. Parr, Museum Director. Above: a close-up of the derrick platform.



American Petroleum Institute

Fractional Distillation

An increasingly familiar sight on the U. S. landscape is the huge oil refinery, with its tall towers, silver globes, and maze of pipes. The illustration at right shows how distillation fractionates crude petroleum.



Heated crude oil is piped into the bottom of the column. A heavy residue settles; the rest rises as vapor. Various petroleum products are condensed and drawn off at different levels.

earth's surface caused fractures, or faults, far underground, which jammed porous rock (containing petroleum) up against non-porous rock. In still other places, the oil accumulated around salt domes or in crevices where the underground formations slope upward.

Almost all of this took place in the millions of years before man appeared on the planet he was to dominate. The early history of man is studded with uses for petroleum products, chiefly wax and asphalt. Nebuchadnezzar is said to have paved the roads to Babylon and the terraces of the fabulous hanging gardens with asphalt. The fuel used to light the altars of the high priest Nehemuh was nepthar, a predecessor of our naphtha. A form of asphalt was used as an embalming agent in ancient Egypt. Alexander the Great, according to Plutarch, visited in 331 B.C. the sacred temples of the "eternal fires" near the present Russian field of Baku on the Caspian Sea. Fifteen centuries later, Marco Polo visited the same "burning springs." The ancient Egyptians, Chinese, and American Indians used asphalt as a medicine and to cover wounds. The Chinese, it's believed, were using oil lamps 3,000 years ago and had fashioned crude hand-dug oil wells more than 1,000 years ago. Some historians believe that the Chinese sank wells hundreds of feet deep and even piped natural gas through crude bamboo tubes. In 1803, more than a half-century before the first commercial oil well was sunk in the U.S., oil was used to light the cities of Genoa and Parma in Italy.

In the United States, as in other nations, petroleum made its way to the earth's surface through natural fissures and springs and left deposits of wax and asphalt. In 1627, a Franciscan missionary reported in a letter to his family in France that he had seen oil springs (*"fontaine de bitume"*) near what is now Cuba, N. Y. In his will, George Washington noted that he had acquired some land in western Pennsylvania because of "a bituminous spring which it contains of so inflammable a nature as to burn freely as spirits, and nearly as difficult to extinguish." By the middle of the 19th century, about 50 small refineries were distilling the "rock oil" laboriously collected from springs and creeks.

By 1857, businessmen in New York and New Haven, Conn., were convinced of the bright potentialities of petroleum, and commissioned Edwin L. Drake, a railroad conductor who had been forced into retirement before the age of 40 by illness, to seek methods of extracting it from the ground. Drake, who had been gratuitously given the unearned rank of "colo-

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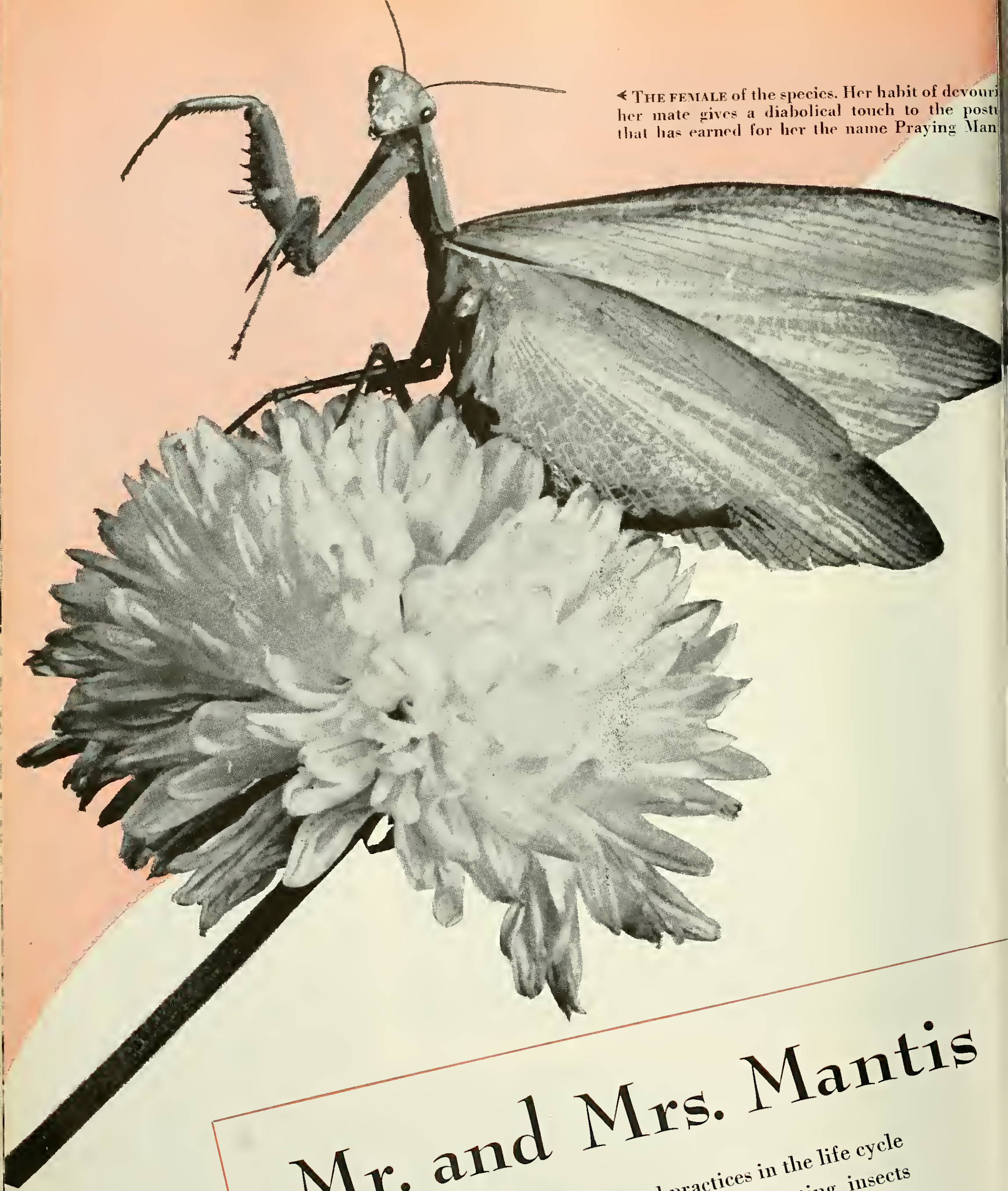
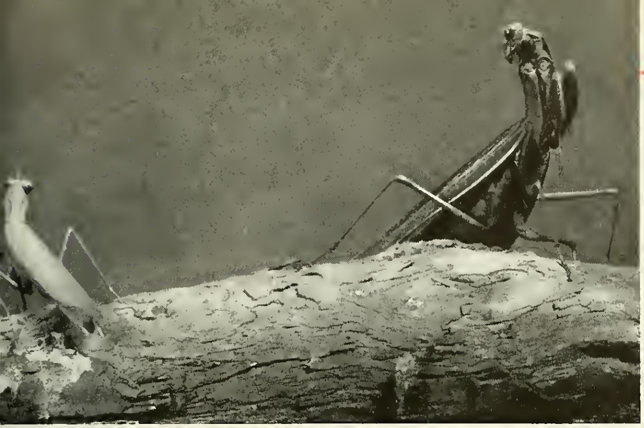


◀ THE FEMALE of the species. Her habit of devouri her mate gives a diabolical touch to the postu that has earned for her the name Praying Man

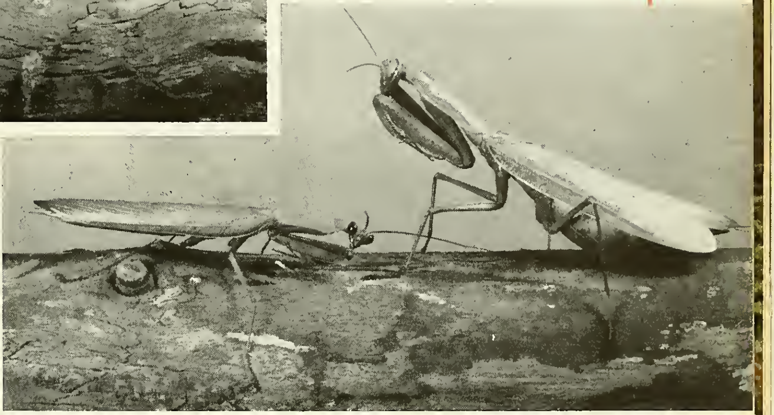
Mr. and Mrs. Mantis

Some remarkable poses and practices in the life cycle of one of our largest and most interesting insects

By ROBERT C. HERMES

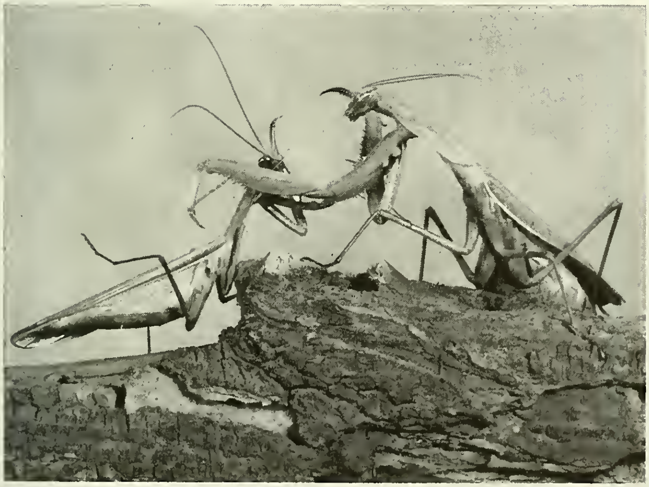


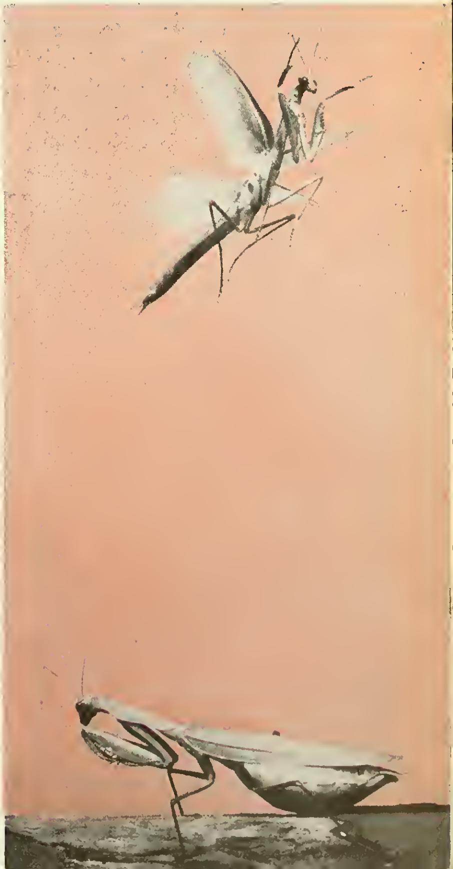
◄ "Boy Meets Girl." Here the female has become aware of the smaller insect who is her prospective mate. She turns her head to watch him. The mantis is one of the few insects able to turn its head. (*Mantis religiosa*)



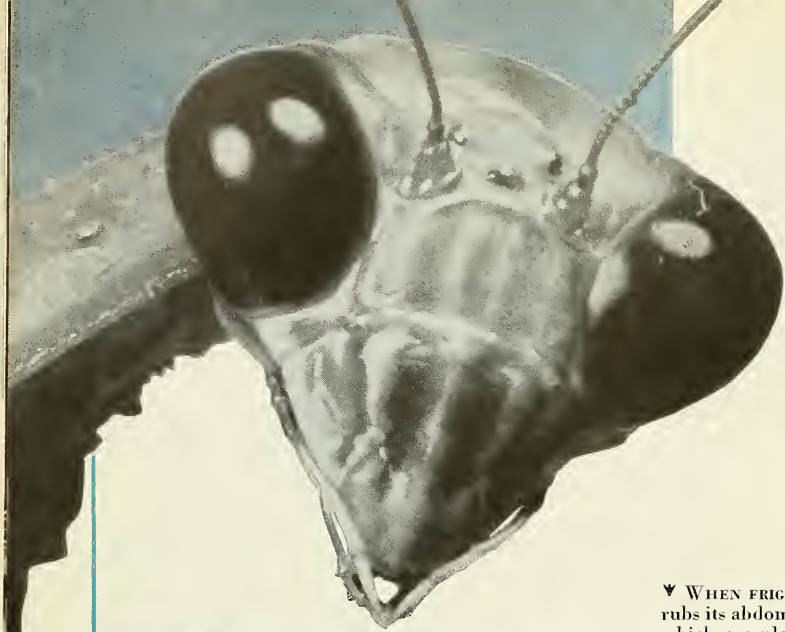
► As the female approaches him, the male apparently tries to make himself as inconspicuous as possible. He crouches lower and lower until his head almost touches the surface, with his delicate antennae waving.

▼ When the male gathers enough strength to approach his lady more closely, she immediately seizes him in her grasping forelegs and then holds him in a vise-like grip for about ten minutes. He frantically rubs his abdomen against his partly opened wings, creating a whirring sound. After she releases him, he backs away and continues to whirr.

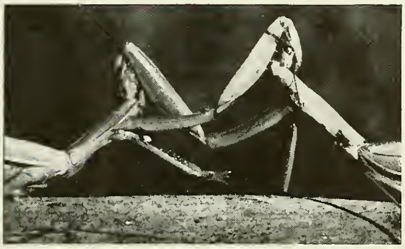




► Sometimes, as in this case, the male abandons his prospective mate and flies off to safer realms.



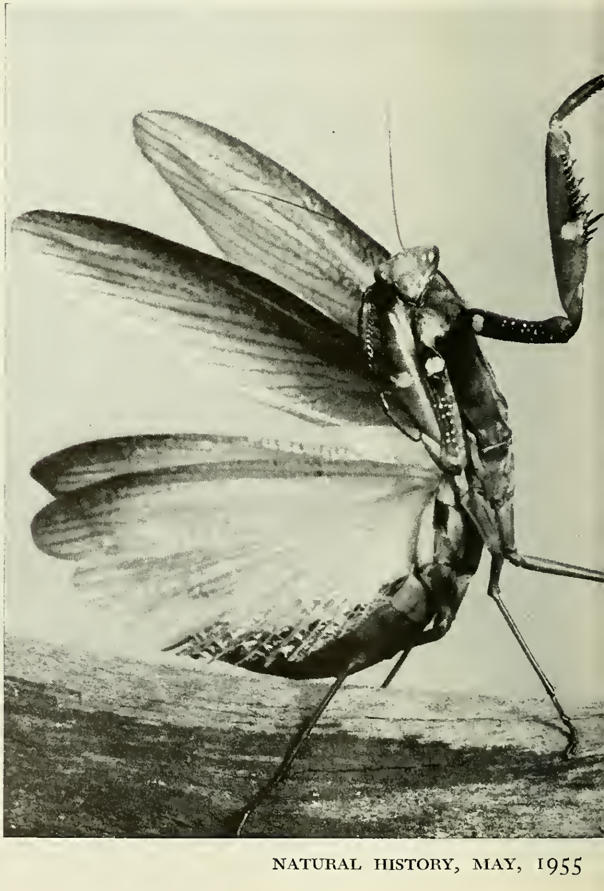
◄ **Portrait** of a female Chinese mantis *(Paratenodera sinensis)*. Her beautiful compound eyes are composed of thousands of tiny lenses, and can change from deep dark wells as shown here to pale translucent gems with only a dark speck in their depths. Between her antennae lie three simple eyes.

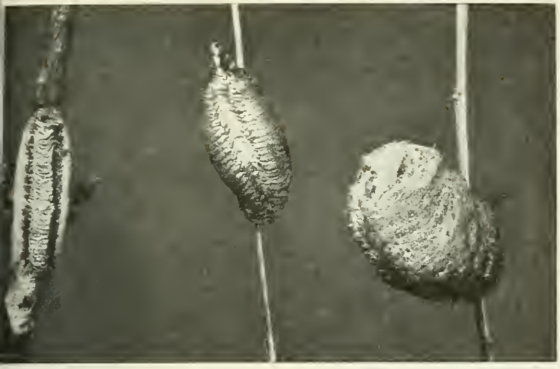


▲ **Two female mantes** in mortal combat. They are cannibalistic, and the fight may end in one of them eating the other. However, they usually prefer smaller and more easily captured prey. *(Mantis religiosa)*

▲ **Feeding** a Chinese mantis with a dropper. Mantes must be given water every day if they are kept in the home. You have nothing to fear from the sharp mandibles or thorny grasping legs, as the insects soon become tame.

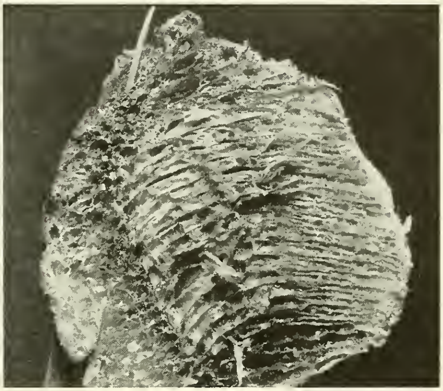
▼ **When frightened**, a mantis raises its wings and rubs its abdomen up and down against the lower set, which are pleated. This causes the whirring noise.

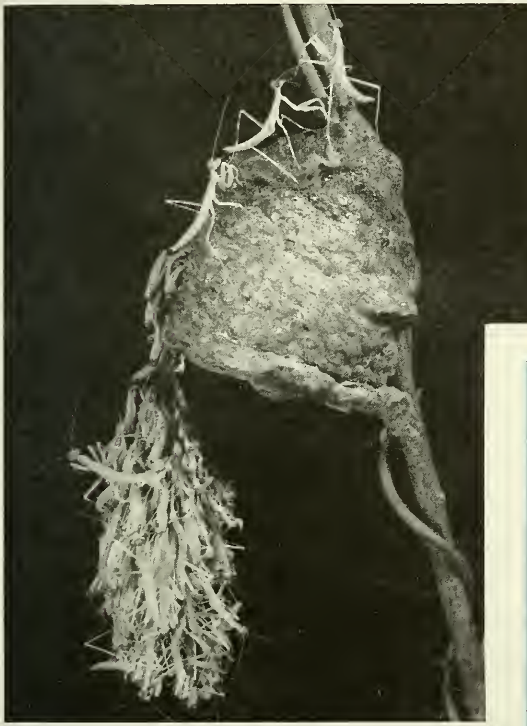




◂ Egg nests of three kinds of mantes. Left. *Stagomantis carolina*; center. *Mantis religiosa*; right, *Paratenodera sinensis.* The nest is made from a creamy substance secreted from the abdomen and smeared into a froth by paddle-like appendages. This quickly hardens. The female lays the eggs in a definite pattern, all pointing toward an escape ridge along the side of the nest. Afterwards, she lives only a week or two and never sees her young.

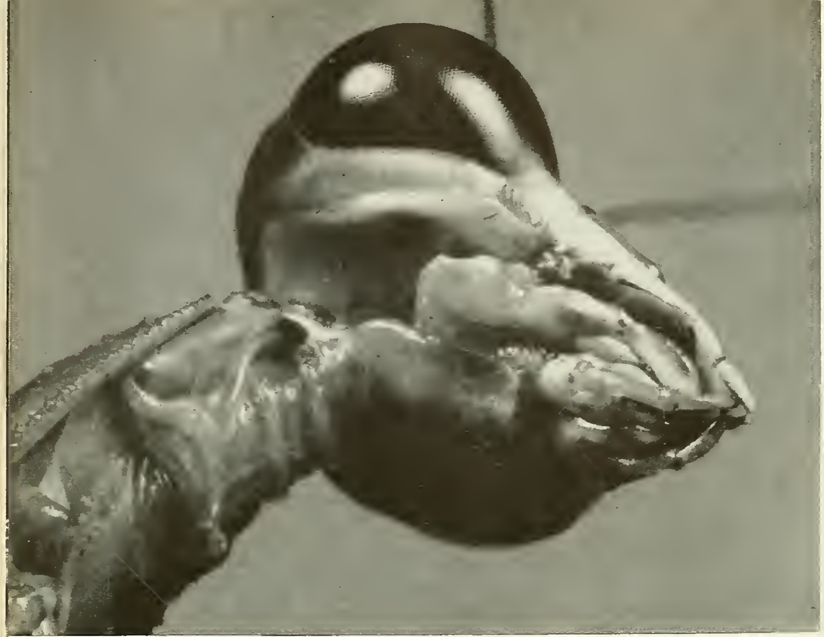
▾ A cross section of the egg nest. The bubble-like structure is an example of nature's ability to produce insulating material.





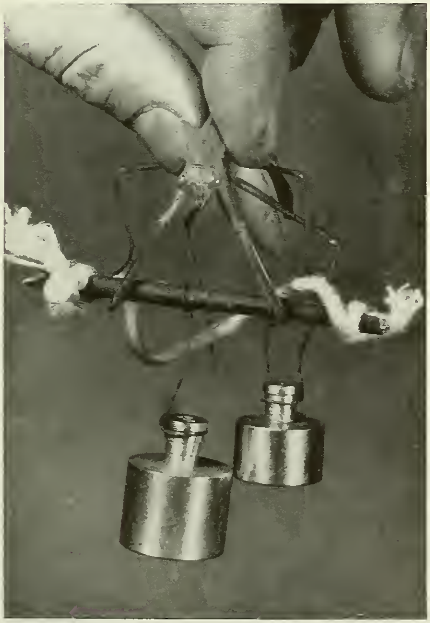
▴ Young Chinese mantes emerging from the egg nest. One after another they wiggle from the nest, each encased in a skin-like membrane that remains fastened to the egg mass by a thin thread. Soon a cluster of tiny mantes form below—dozens of squirming insects splitting their birth sacs and pulling themselves loose. They sometimes hang 2½ to 3 inches below the nest.

▸ The hatching stage is a critical time in the life of a mantis. The young insect is not only subject to the ravages of ants but also to attacks from insect-eating birds, like this chickadee.

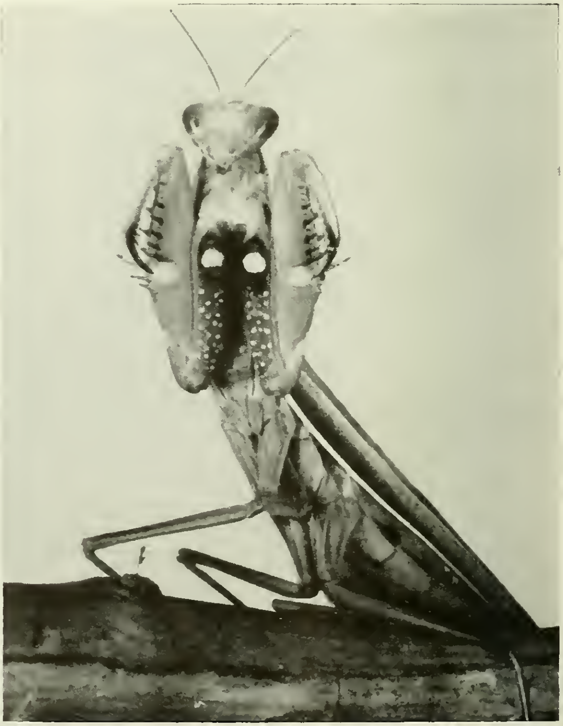


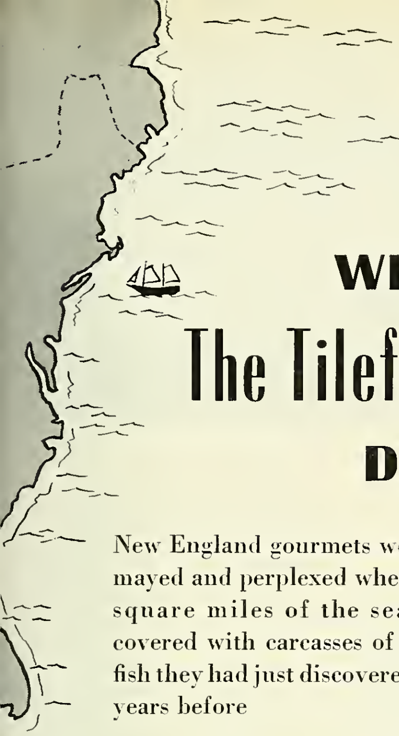
◀ THIS VIEW SHOWS well the mantis's extraordinary neck, which enables the insect to turn its head more than half way around. The finger-shaped palpi contain taste cells and are used by the mantis for bringing food into its mouth.

▼ THE PECULIARITIES of the mantis have made it the subject of countless experiments. This mantis weighed one-fifth of an ounce. The photographer held the insect while it grasped a weighted stick. The stick had been loaded with three ounces, and the mantis held it easily with its powerful forelegs. This is quite a feat, when you stop to think about it. Can you hold fifteen times your own weight?



▼ SOME INSECTS display artificial eyes, which may help to protect them from other creatures. Note that this mantis has two of them, which become conspicuous when it assumes a defensive posture.



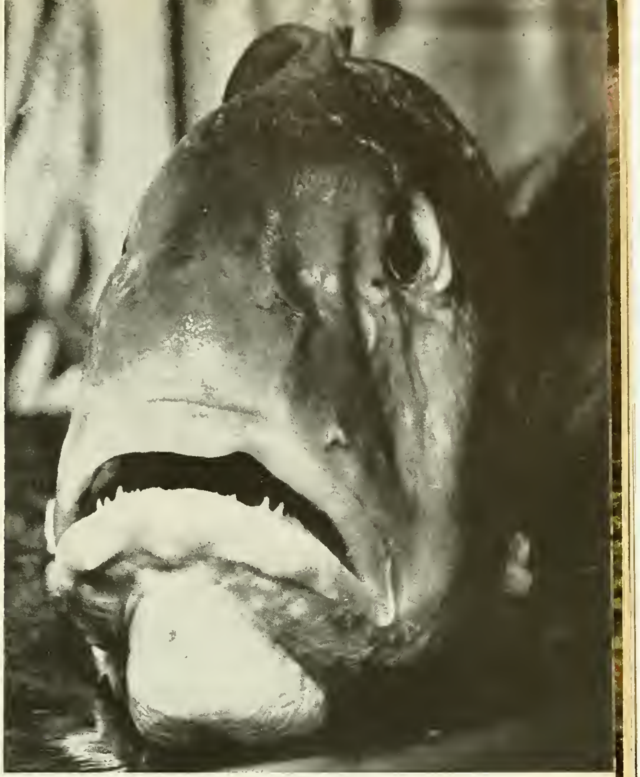


When The Tilefish Died

New England gourmets were dismayed and perplexed when 4000 square miles of the sea were covered with carcasses of a tasty fish they had just discovered three years before

By Bernard L. Gordon

Photographs by the author



▲ Head-on view of a tilefish shows the large mouth and conical teeth. Though it is a bottom feeder, the eyes are placed higher than on most fish.

OF ALL the fish caught commercially off our coast, the large and brilliantly colored tilefish probably has the most unusual history.

Strangely enough, the tilefish was unknown until May, 1879, when Captain William H. Kerby of the schooner *William V. Hutchins* caught the first specimen south of Nantucket Lightship in 150 fathoms of water while working cod lines. When his crew found that the plentiful fish made an unusually tasty meal, some of the specimens were salted down and taken to Gloucester where a portion of the catch was smoked.

Gourmets quickly recognized the fish's merits; some rated it equal to pompano. (It is delicious baked, boiled, or fried, and is very tasty in a steaming chowder.) The tilefish was on its way to becoming a favorite. Little did anyone realize that within a few years after its discovery, it was to be knocked almost completely out of existence.

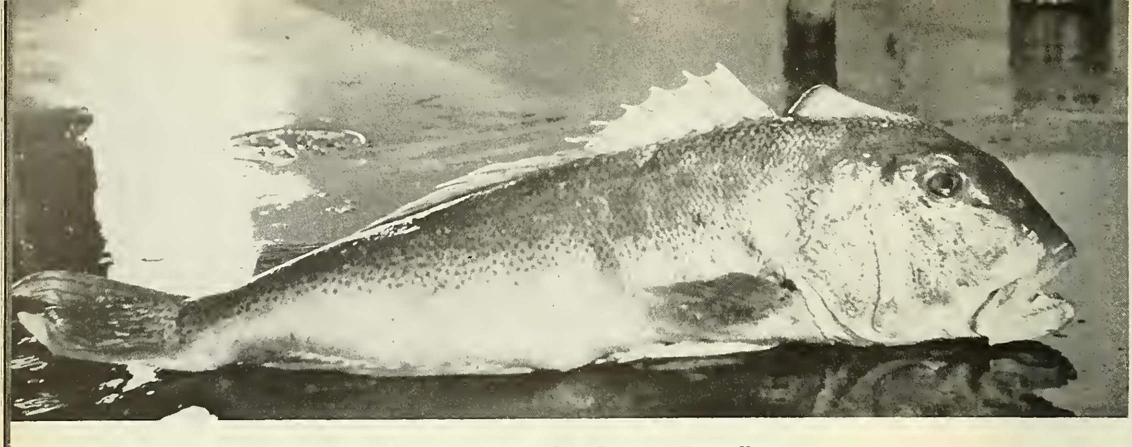
Since neither Captain Kerby and his crew, nor the fishermen at the dock in Gloucester had ever seen the fish before, Kerby sent a specimen to the U. S. National Museum. The Museum declared it to be a new genus and species belonging to a tropical family inhabiting the Gulf of Mexico. Prof. George Brown Goode and Dr. Tarleton H. Bean gave it the name of *Lopholatilus chamaeleonticeps*, which means "the crested tilus with a head like a chameleon." Fishermen understandably shortened the name to tilefish.

Catches of the new fish by other boats prompted the U. S. Bureau of Fisheries to send out expeditions to study it off southern New England in the summers of 1880 and 1881. Tilefish were found to be plentiful enough to support an important new fishery. Everyone was happy.

Those who studied the fish found that it occupied a very definite part of the ocean—a narrow band along the outer edge of the continental shelf where the sea floor is bathed by warm water from the Gulf Stream. The temperature of the water here ranges from 47 to 50 degrees, with very little variation from season to season. As far as is known, the tilefish never leaves this limited habitat to venture into the cooler water of the landward shoals or the frigid depths of the Atlantic abyss.

It was apparently this inability to tolerate changes in environment that brought near-annihilation to the tilefish just three years after its discovery.

On March 3, 1882, Captain Lawrence of the bark *Plymouth* of Windsor, Nova Scotia, sailing to New York, recorded the following



▲ The tilefish is bluish or olive green on the back and upper sides, yellow or rose lower down. Its belly is reddish, with a white midline. Small yellow dots are scattered over the body. On top of the head is a fattish, greenish-yellow flap.

▲ Captain Frank Sinnett displaying a tilefish (left) and a wolf fish taken 135 miles south by east from Block Island. He has caught as many as 516 tilefish in one drag. Tilefish average from 15 to 25 pounds and run from 2 to 4 feet in length. A few 50-pounders have been reported.

description in a report to the Fisheries Commission Board: "We were sailing off George's Bank, and about daylight on Sunday morning the mate came down into the cabin and said that the bark was passing through a lot of dead codfish and wanted to know if we should get some of them. I went out on deck and saw that the water all around us and for miles back of us was filled with these fish. Their gills were red, and upon scooping up some of them I found that they were hard, showing that they had not been dead very long. From six o'clock in the morning until five o'clock in the evening, we were passing through this school of fish, and as we were sailing at the rate of six knots we went through 69 miles of them."

A week later the brig *Rachel Coney* sighted the dead fish 75 miles south-southwest from the Lightship on the south shoal of Nantucket and sailed through them for 40 miles. Ole Jorgensen of the Norwegian bark *Sidon* reported that in latitude 40° North and longitude 71° West there were dead and dying fish as far as the eye could see in all directions —"thousands of them, even millions . . . " This was on March 14. One week later, the schooner *Navarino* sailed through them for a distance of 150 miles.

Tabulating these and other accounts, the range of destruction was found to extend over an area 170 miles long and 25 miles wide, covering at least 4,000 square miles! The Bureau of Fisheries estimated that almost 1½ *billion* tilefish perished. It was then believed that the entire species had been eliminated.

Scientists offered this explanation: Tilefish are bottom dwellers in about 100 fathoms of warm water. In 1882, the Gulf Stream, near the edge of which the tilefish dwell, moved farther out to sea, leaving them in cold water. They could not follow the shifting Stream, as the bottom of the ocean drops abruptly near the 100-fathom line. Consequently, almost the entire population was killed.

Whether or not this explanation was correct cannot be stated definitely. In any case, not a single tilefish was caught anywhere for approximately ten years, although frequent searches were made. It was not until 1892 that they were found again. In that year, the *Grampus* took eight fish, and in the following year, 53 others were caught. As the years passed, the tilefish re-established themselves, and by 1915 they were plentiful enough to become popular on the market. From July 1, 1915, to July 1, 1918, 11½ million pounds were landed. In 1950, almost 2½ million pounds were landed on the Atlantic Coast, with a value of more than $150,000. Tilefish have been reported up to 50 pounds, but they average between 15 and 25 and are from 2 to 4 feet long. They have been found from the Banks of Nova Scotia down to the Gulf of Mexico. However, they are most plentiful in water from 50 to 80 fathoms in the region from Nantucket to Cape May, N. J.

The tilefish is easy to recognize because its dazzling hues call to mind a tropical fish. It feeds on a variety of bottom-dwelling invertebrates, chiefly crabs it seems. It will take almost any kind of bait but seems to prefer cut menhaden. Mature females taken in July and August are full of ripe eggs, indicating that spawning occurs around that time.

The tilefish has been doing well since the devastating year 1882 but no one can predict when the indispensable Gulf Stream will play another trick on it.

THE AGE OF PETROLEUM

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nel" by his business associates, went to Titusville in northwestern Pennsylvania, then a lumber community on the banks of Oil Creek. He first tried to sink an artesian well, but its walls collapsed. He then sought drillers with experience in drilling for salt water deposits, but two men he hired for the job never appeared. His funds gave out and his backers were slow to send new funds, but Drake won a personal loan of $500 from two friends in Titusville. He then engaged another brine driller, a blacksmith named Billy Smith. Smith's first efforts failed because the hole he drilled repeatedly filled with water or mud as soon as the drill was removed. Drake then bought a load of iron casing which was sunk into the hole with the drill. At 36 feet, Smith encountered solid rock but drilled slowly through it until he had pushed the drill down to 69½ feet.

One Sunday morning late in August, 1859, Smith visited the well site with one of his sons. They peered into the casing and saw a rising level of black viscous liquid. Drake arrived at the site the next day and Smith dramatically pointed into the well. "There's your fortune," he said.

It was the first instant in the new Age of Petroleum.

At first the well flowed at the rate of only 15 or 20 barrels a day; and all the wells sunk in 1859 in America produced only 2,000 barrels. Since then, 1,580,922 oil wells have been drilled in the U. S. and production has risen to 2¼ billion barrels of crude oil a year. In 1954, at least 51,000 new wells were drilled while more than half a million wells—93 per cent of them in the U. S.—were in operation all over the free world. The deepest hole ever drilled went down 21,482 feet in a well about 25 miles southwest of Bakersfield, Calif., and was halted last March without striking a paying deposit. (The temperature at the bottom of such a well is about 330 degrees F.) The deepest producing hole is located in Louisiana; it has produced oil between 17,497 feet and 17,892 feet. In the early days operators planted derricks almost leg to leg in the belief that more wells meant more oil. Now wells are carefully spaced, usually one to every 40 acres but sometimes only one in 80 or 160 acres.

While methods of finding oil have become increasingly scientific and expensive (it costs from $10,000 to $60,000 a month to keep an oil-hunting crew in the field), methods of *extracting* oil have remained basically the same. No economical method other than drilling has ever been found, though others have certainly been sought. Two types of drilling are in use—the cable-tool method and the rotary drill method.

The cable-tool method has a history going back to the very first well of the Age of Petroleum. It consists of pounding a steel drill repeatedly against an underground formation, thus crushing the rock or soil like sodden sand under a hammer. But the cable-tool method, not too practical for a well deeper than 10,000 feet, has been replaced largely by the rotary drill method, now in use in 83 per cent of U. S. oil wells.

The rotary drill method suggests a huge auger biting into a chunk of wood. At the surface, an engine turns a round turntable, which grips in its hollow center the square shaft of the drill. As the turntable revolves, the drill shaft also revolves and the bit, sometimes as much as three or four miles underground, chews away at the rock. In soft formations, the drill may sink rapidly; in hard rock it may go down only a few inches an hour, then be worn out. Some wells have been abandoned because the rock was too hard to permit further drilling.

The wooden derrick has given way to the steel derrick, but the function of the spindly scaffolding has not changed. From the top, 80 to 189 feet above the ground, the rotary drill shaft is hung. This tech-

Transporting Petroleum

Philip Gendreau

▲ The U. S. now has approximately 186,000 miles of pipeline. Here, a giant digger scoops out a trench.

Philip Gendreau

▲ A fleet of tank cars is assembled in this busy rail center near a large refinery in Bayonne, New Jersey.

American Petroleum Institute

▲ Tankers carry petroleum to distant parts of the globe. The largest can handle 16.6 million gallons.

nique solves one of the kinky problems of drilling: how to keep only a small part of the weight of the drill shaft on the bit, so it will bore smoothly through the rock. If the entire weight of the drill shaft were placed on the bit, the shaft itself would twist and crumple like a soggy straw.

As it dangles deep in the ground like a giant string of macaroni, the drill shaft is neither naked nor simple. For every 30 feet that the drill probes, another length of shaft is added. It becomes as flexible as string and, in fact, the direction of the drill can be changed gradually by inserting a special wedge called a "whipstock" into the well beneath the drill. Around the drill shaft, steel casing is lowered, one section after another and occasionally getting smaller, until it looks in cross-section like a gigantic, much-elongated telescope with the eyepiece at the bottom of the well. The diameter of the well at the surface varies from one to three feet.

The shaft of the rotary drill is itself hollow. Into it is forced a special mud. This may be made up of a mixture of water, aquajel, caustic soda, baroid, and "quebracho," a vegetable product from Brazil. The mud cools the bit as it flows out between the teeth, and forces the dislodged rock and rock cuttings up the annulus of the well, sealing the walls.

Once the drill reaches a good oil-producing level, it is withdrawn. The derrick is then carried away to be used elsewhere, and a spiky unit of metal arms and valves called a "Christmas tree" is mounted over the well to regulate flow.

The image of a well drawing oil out of a subterranean lake like a gigantic straw is misleading. In many instances, the oil flows up the well impelled by incredible underground pressures. Because of this phenomenon, one-fourth of the oil wells in the U. S. produce three-fourths of the petroleum. If the oil is slow in rising, a nitroglycerin charge may be set off at the bottom of the well or acid may be pumped down the hole to enlarge the pores of oil-bearing limestone. Frequently the oil is sandwiched between a layer of natural gas on top and a layer of salt water on the bottom. If the underground pressure drops too low to force the oil up the well, the gas or salt water may be extracted and pumped back into the deposit at another point to flush the oil up the well. At one time it was believed that as much as 75 per cent of any petroleum deposit might escape extraction. Today, in a very efficient field, less than 20 per cent of the original deposit will be left underground. Some operators, using improved techniques, have returned to old wells and worked them successfully a second time.

With the birth of the Age of Petroleum, the industry of oil production was swiftly augmented by two other equally important industries — the *transportation* and the *refining* of petroleum.

The first oil was pumped into barrels and shipped to refineries by river barges or by wagon. At one time, Oil City, Pa., only a few miles south of Drake's well, had 6,000 two-horse teams and wagons—and congestion to match that of our present cities—in its streets. By 1865, the first "long-distance" pipeline had been built in western Pennsylvania. It was five miles long, two inches in diameter and could handle 800 barrels of oil a day. Today the U. S. has some 186,000 miles of pipelines, which can handle about seven million barrels of oil a day. It takes a quarter-million barrels of oil even to fill a 12-inch pipeline 330 miles long. Pipelines are now the fourth largest domestic freight carriers in the country, behind railroads, trucks, and waterway carriers, in terms of tonnage. For international transportation of oil, ships are by far the dominant carrier. The average American tanker can carry about 14,000 tons of oil, but several have been built in recent years that can carry up to three times that amount.

Just as vital to the swiftly-burgeoning development of the Age of Petroleum was the refining industry. By 1954, some 2,347 different products were being manufactured within refineries, according to a recent count from the American Petroleum Institute, and owners were building huge structures without walls or ceilings for fear they would become inadequate before they reached peak production. The backbone of the refining industry is still the distillation of crude petroleum.

Essentially, distillation is a process of heating the petroleum to about 800 degrees F., then passing it as vapor into a huge steel cylinder called a fractionating tower. The vapors of the various elements in crude petroleum tend to separate in the fractionating tower, the lighter vapors — of gasoline, kerosine, and naphtha — rising to various levels near the top of the tower, and the heavier vapors—of heating oil, lubricating oil, and heavy fuel oil — settling to lower levels. As each vapor cools (at a different temperature at different levels within the tower), it condenses into a liquid and is drawn off as a separate product. An important adjunct to distillation is the cracking of petroleum. Cracking is a process of breaking—or cracking —the heavier hydrocarbons in petroleum and reassembling them in a different way to make more of the lighter products.

Throughout its development, the Age of Petroleum not only made new products available from its own prolific substance but stimulated the development of other products. These, in turn, frequently created a demand for new petroleum products. An example is gasoline, which made the gasoline engine and then the automobile and airplane possible. Because of the gasoline engine, John D. Rockefeller saw his already immense fortune quadruple between the time he retired in 1896 and his death in 1936. Because of the demand for gasoline, world production of petroleum doubled between 1919 and 1926 and doubled again in the next 11 years. Also, the catalytic cracking of petroleum was developed, which not only increased the quality of gasoline but also the quantity. Cracking made it possible to produce almost twice as much gasoline from a barrel of crude petroleum as is possible through straight distillation.

Every year the petroleum industry spends an estimated $100 million on research. It has found ways to cause oil, which naturally floats on water, to creep under a film of water on a metal surface and lift it off, thus preventing rust. It has found ways to use oils to synthesize the sheerest of fabrics and the toughest of rubber tires. It has even discovered ways to secure the energy of liquid petroleum from hydrocarbon molecules found in coal, gas, sawdust, and cornstalk. It is believed that there are enough coal reserves in the U. S. to provide the nation's liquid fuel demands from this source alone for centuries and still leave enough coal for everyday use. The only restraint on plunging ahead with the process is economic—the demand is not yet great enough to persuade the petroleum industry to spend the billions of dollars necessary to make an abrupt shift to coal as a source for liquid fuel.

In the recent years of the Age of Petroleum, specifically since 1944, the U. S. has become an importer of oil. This did not result from necessity—the U. S. still has enough reserves to produce more than its annual consumption—but the petroleum industry prefers to import some petroleum products, such as heavy fuel oils, by tanker from oil fields in Venezuela. The industry would rather produce here the more volatile and profitable petroleum products, such as gasoline and kerosine, than the less-profitable residual oils. But the importation of petroleum is itself under controversy. Those favoring it claim we thus conserve our own reserves against an emergency that may some day prevent us from importing oil. Those opposing it claim we are neglecting further development of our own resources, particularly labor force and plant capacity, which may become necessary in an emergency. The latter view has not

Petroleum At Work

▲ A B-47 jet bomber's range is extended by refueling in the air.

▲ Diesel locomotives outnumber steam and electric types by 3 to 1.

▲ The *Queen Mary* burns almost 2500 tons of fuel in one crossing.

Philip Gendreau photos

▲ The combine does a big job harvesting wheat on the western plains.

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prevailed for more than a decade.

The Age of Petroleum so far has been augmented, not eclipsed, by the sudden arrival of the Atomic Age. Since the end of World War II, petroleum production has gone up almost 35 per cent. The prime products of the Atomic Age thus far have been military in nature—and the best of those weapons are useless unless they can be delivered by machines consuming petroleum. Even though the world thinks of the future in terms of atomic energy, the petroleum industry is not despairing. It points out that, after 10 years of the atomic age, nuclear energy has not yet been developed for civilian use. It believes that general use of atomic energy will be frustrated in many fields because of the dangers of radiation. But it bases most of its hopes on the belief that the demands for power will rise so abruptly in the future that petroleum will co-exist with the atom. Robert E. Wilson, Chairman of the Board of Standard Oil Company (Indiana), predicted last November that the world's population will increase three-fold and the demands for power will increase tenfold in the next century. Thus, he says, every source of energy will be used—and gratefully.

Even though petroleum may not reign eternally as the major source of power, it will profoundly influence all other technological phases of our civilization. Already, it has traced a glittering curve of hope and achievement which the Atomic Age should, in a peaceful world, send to greater heights. It has demonstrated that energy is power—political, physical, and economic. Within a few generations it has transformed the living habits and hopes and fears of most of the world's population. There is no doubt that the moment in time we call the Age of Petroleum will stand out as one of the most significant in the long history of the world.

HOW DID THE ANCIENTS DO IT?

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feet thick—in other words, approximately 4000 cubic feet of extra heavy rock. There is a "tired stone" which did not reach the site. Wendell Bennett expressed his belief that the Incas moved their building stones on log rollers by means of pry bars. It is also logically possible that, having invented the equal arm balance for weighing things, they were able to lift great boulders by pivoting them from a lever counterbalanced by the cumulative weight of many smaller stones loaded into a sling or basket at the other end of the arm. With such an "engine," they may have been able to "walk" great boulders to the building site and then hold them suspended until close fitting could be achieved. The loading and unloading of the smaller boulders and the resetting of the pivot pole would not be especially difficult.

It is astonishing that man performed most of his extra-heavy engineering at a time when he had not yet even harnessed powerful animals to do his bidding. How thrilling it would be if we could but capture some of the ancient scenes and see in detail how the Peruvians, Egyptians, or Druids of old performed such prodigious feats that centuries of time have not been able to efface their work. Even a violent earthquake could not overthrow 6 of the massive columns at Baalbek, which are 62 feet high and 7½ feet in diameter. Each consists of three blocks bound together with bronze pins. Travelers today stand speechless before their grandeur, powerless to explain how human hands could have put them in place. Granting that the ancients who did this must have found a method of dividing the task into many small units of exertion, it still remains astonishing that the human spirit could be capable of such determination as to erect 58 of these gigantic columns around the shrine of one temple at this site. We shall do well not to forget these works even though we have risen irrevocably into the era of push-button engineering.

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escape in an automobile accident. Even years later, he remarked to the author, while waiting for the light to change in his favor on a New York thoroughfare: "God has always pulled me through the pinches, and I'm not gonna put undue strain on our relations."

Joseph M. Chamberlain

ANIMAL COURTSHIP

- - - - - - - - - by Maurice Burton

Frederick A. Praeger, $4.00
267 pp., 10 photos, 49 drawings

THE author states in the preface that when he first started writing this book he considered himself a "novice," but during the ensuing two years he learned much about courtship in animals. To call himself a beginner is a reflection of modesty because Maurice Burton has been writing and lecturing about the ways of animals for a good many years. That he just "learned much" in two years is also an understatement, for this book is a masterly, well-organized, and accurate account of courtship behavior in the animal kingdom. The most appropriate studies serve as illustrative examples, which are presented in a pleasant and lucid manner, with the load frequently lightened by a large series of delightful sketches and photographs.

Dr. Burton did not intend to produce just another descriptive text. He had a much more far-reaching objective; in effect, a theoretical dissertation on animal courtship written in such a manner that the layman would read it and could understand it. The major thesis is the evolution of courtship behavior from protozoa to man, and an analysis of the underlying factors.

Theoretical discussions are necessarily much more controversial than factual presentations, and personal preferences are likely to enter into the picture. Scientists must nevertheless evaluate theories if advances are to be made. Decisions are reached on the basis of supporting factual evidence, scientific methodology, and basic philosophy. In this respect Dr. Burton is less successful. Many of his theoretical arguments and explanations are decidedly inadequate and leave much to be desired. A single example must suffice.

For some time psychologists have used the term "drive" (or motivation) in a descriptive sense (e.g. hunger drive, sex drive) to describe any tendency to behave in a certain way, and this may be correlated with the hypothetical physiological and psychological state of the individual at the given time. Some have gone a dangerous step further and consider the drive an additional entity, an inner energizing force. Dr. Burton adopts and expands this shaky concept and uses it as a causal explanation for behavior and even for physiological and morphological processes. Thus an amoeba divides in two because of the reproductive drive; a single-celled radiolarian builds an external skeleton, and a man builds a house as a result of the creative drive; and the praying mantis is led to the jaws of the female by the self-destructive drive. This is like explaining the working of a gasoline engine as the result of the "automotive drive," whereas a more scientific explanation is clearly required in terms of a spark exploding gasoline vapors, which push down a cylinder connected with a crankshaft. Similarly the division of an amoeba can be discussed in terms of increasing mass, sol-gel transformations, and the concentration of specific ions, and then interpreted on this basis as a unitary organized process. Good beginnings have been made in analyzing behavior in terms of interrelated biochemical, physiological, and psychological processes. These are admittedly more difficult to comprehend and are at best partial explanations. There are, of course, many blank spaces to be filled in by further research. Dr. Burton tends to minimize such discussions in preference for more nebulous phrases that may carry an impression of great profundity but actually have rather limited scientific value.

Readers seriously interested in animal behavior will surely profit by a careful reading of this book, for it will undoubtedly stimulate thought and discussion, but it cannot be endorsed as a popularized version of present-day behavioral theory.

Lester R. Aronson

CLIMBING ROSES

- - - - - - by Helen Van Pelt Wilson

M. Barrows and Co. Inc., $3.50
212 pp., 48 black and white and
8 color photos, 16 pp. of line drawings

CLIMBING roses are so easy to grow, so rewarding in their profusion of flowers that few gardens are without them; yet, it is 20 years since a new book appeared on the subject although the number of varieties available has grown vastly. Here at last is a comprehensive and charmingly written account designed, in its simplicity, for the amateur, but which will give pleasure and instruction to the seasoned rose-fancier as well. From a master-list of over 300 varieties some 75 have been selected for fuller treatment, and of these many are illustrated in color or black-and-white. The chapters on culture are most well done, and their line-illustrations, especially of pruning, are outstandingly clear and informative. There is a guide to the best kinds to grow in different parts of the country, and a list of nurserymen. Indeed, from the point of view of usefulness, this unpretentious volume should hold its own for a long time to come.

Nicholas Guppy

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Florida State News Bureau

▲ This venerable cypress at Longwood, Fla., nick-named "The Senator," is the largest tree (13½-foot diameter) east of the Mississippi River.

quent stops to rest and drink the cool swamp water. It tasted like an elixir of the gods.

"Congratulations," Roy told me, as I lifted my legs into the car. "I'm sure you're the first white woman to go seven miles through that swamp."

Panthers still prowl the Big Cypress. The most succinct short story I ever heard came from the cypress loggers: "Down by Jones' mill one day, panther jumped an Indian; they killed each other. Indian had a knife; panther didn't need one." Sam Whidden, who made a bountiful living trapping otters in Corkscrew some 30 years ago, told us that otters, along with the wild turkeys and deer, are much more numerous in Big Cypress in recent years. This is probably because since 1946 nearly half of this swamp has been a wildlife management area, open only to controlled hunting during a specific portion of the season.

The game preserve spreads over most of the general area known as Corkscrew, a name coined in the 1800's by surveyors who traveled a winding river inland from the Gulf of Mexico. Though Corkscrew became the name of the big inland marsh, the name of the river was changed to Sever's Creek early in this century, and finally in what Graham Whidden calls "a try at getting fancy" to Imperial River.

Every time we heard the distant drilling of a woodpecker, we could not help but wonder if it might be the big ivory-billed. In 1925 ornithologist Bailey described Big Cypress as the Florida stronghold of this bird, which may now be extinct, and as recently as 1948 an ivory-billed woodpecker was reported in Big Cypress.

A place well worth visiting in the swamp is Stumpy Strand, a "Big Cypress" forest in miniature, clear of underbrush and thick with bulging-based pond cypress trees of near-uniform height. Pond cypress has recently been reclassified as a variety of bald cypress; the similarities and differences between the two have kept foresters scratching their heads and fussing with the classification for years. In Big Cypress we found both types of foliage on the same tree, and bald cypress leaves sprouting from pond cypress stumps.

Stumpy Strand is accessible by jeep during most of the year, provided you have a guide who can locate it.

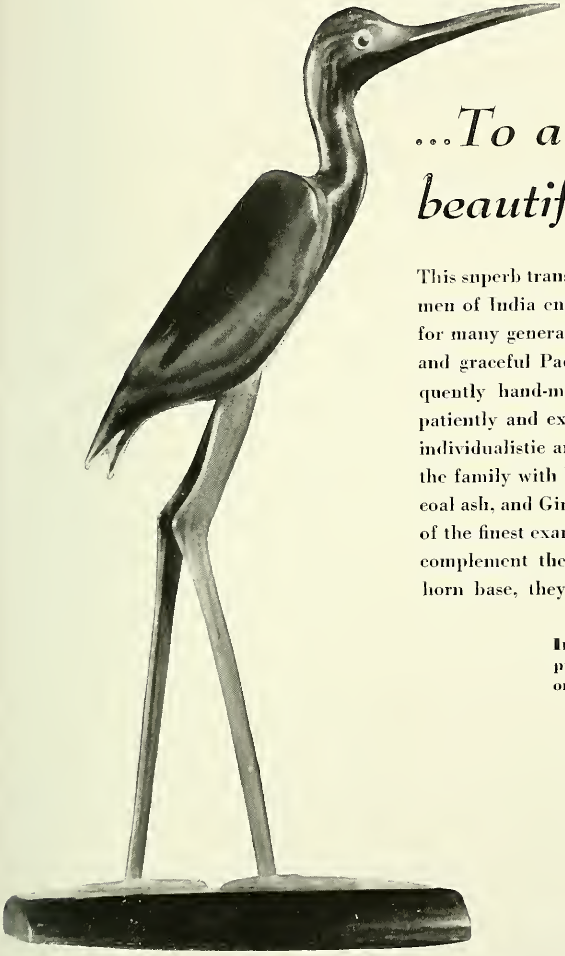
A new highway under construction from Immokalee southwest to Naples will come within about a mile of the Corkscrew cypress. From the highway you will be able to see a stand of virgin pine, an important relic of the once-vast area of hard-pitched southern slash pine. Here also you will see the abrupt break in the cypress skyline between the logged and unlogged swamp.

Only last year the critical cypress situation became generally known. Though the United States still has 8 billion board feet of cypress timber, only three possible "museum stand" areas remain—each containing at least a square mile of reasonably dense virgin trees up to six feet in diameter in true cypress swamp. These are the Dinner Pond cypress of Okefenokee Swamp in Georgia; the Grassy Lake area near Hope, Arkansas, and the magnificent bald cypress here in Corkscrew.

For individual big trees, we also have a 13½-foot diameter bald cypress at Longwood, Florida, and a 12½-foot cypress at a fork of the Obion River in western Tennessee —the two biggest trees east of the Rocky Mountains.

Every time Jack and I wade out from the big trees and head the jeep back through the Florida twilight to town, we start thinking about the next time we can go back into Big Cypress Swamp, for as Graham Whidden says, "It's just clearly one of the most beautiful places God put on this earth."

From a crude Water Buffalo horn...



...To a beautiful artistic carving!

This superb transformation is hand-fashioned by the skilled craftsmen of India employing an art handed down from father to son for many generations. Their favorite subject is the very beautiful and graceful Paddy Bird shown here. Using primitive tools, frequently hand-made from discarded pieces of metal, the carver patiently and expertly cuts the crude horn to form these highly individualistic art pieces. The polishing is done by the women of the family with local materials like leaves from the Karsena tree, coal ash, and Giringa wood. These stunning figures represent some of the finest examples of one of India's oldest handicrafts and will complement the most discriminating decor. Mounted on a solid horn base, they are offered to you at an unusually low price.

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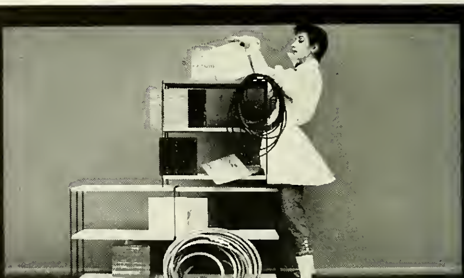

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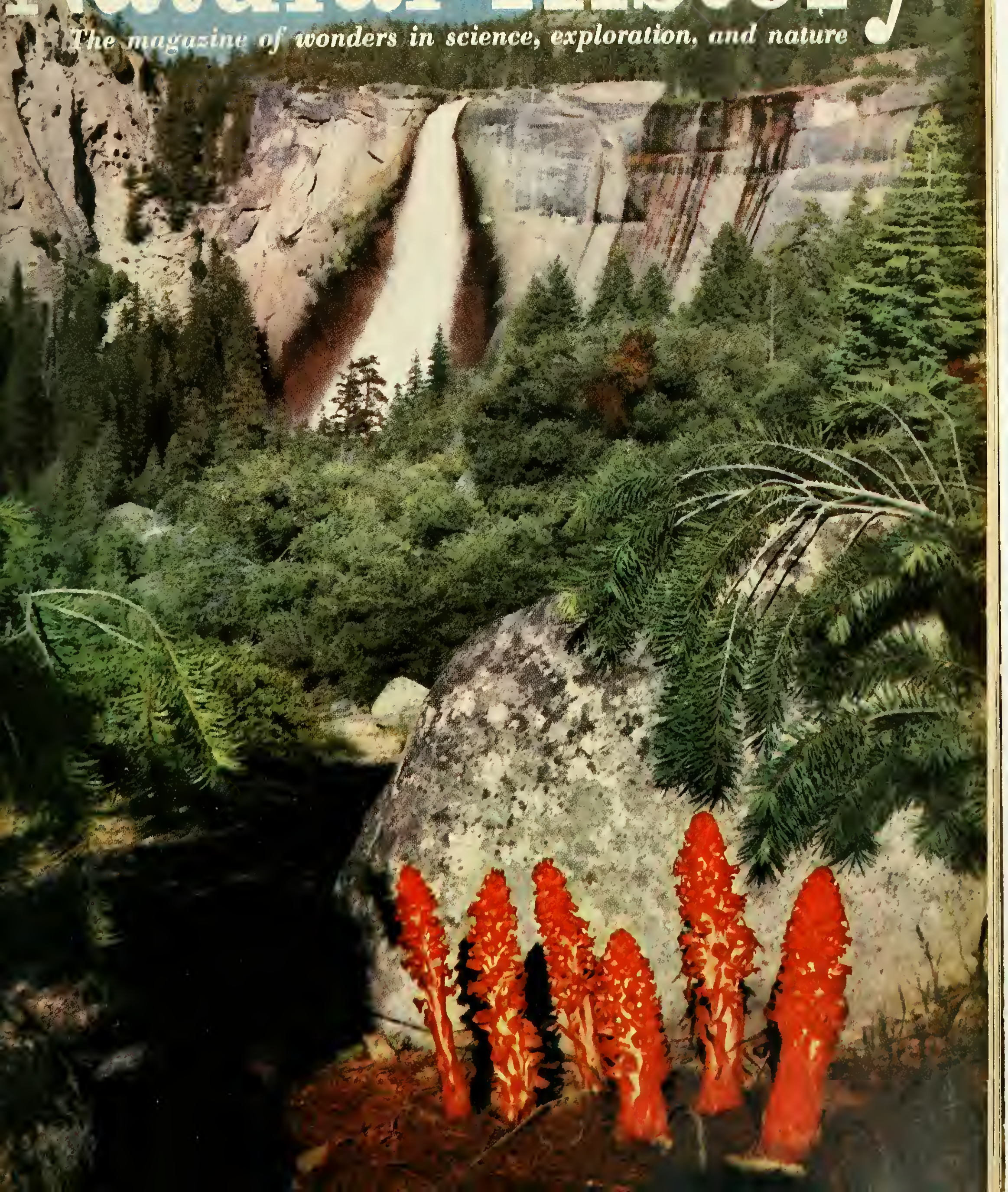

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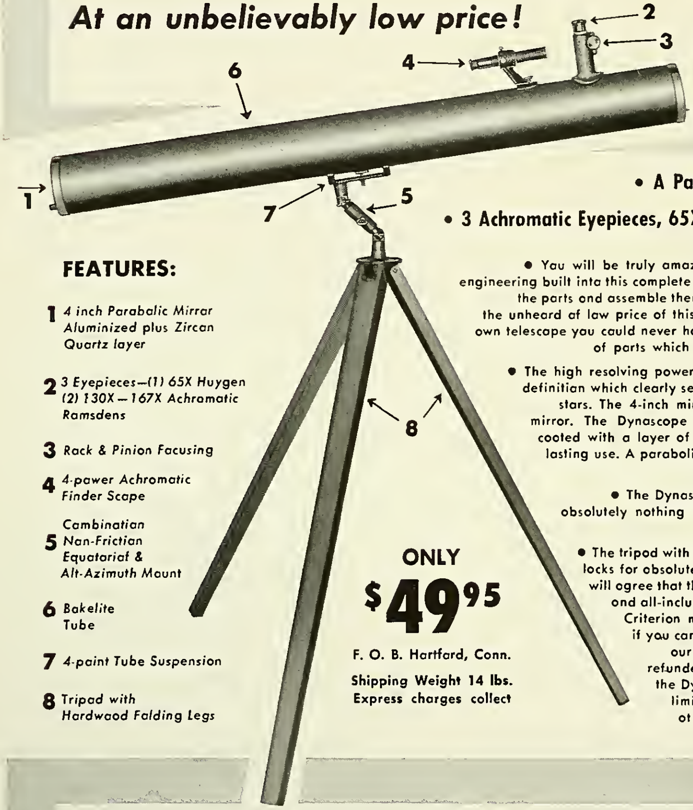

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LETTERS

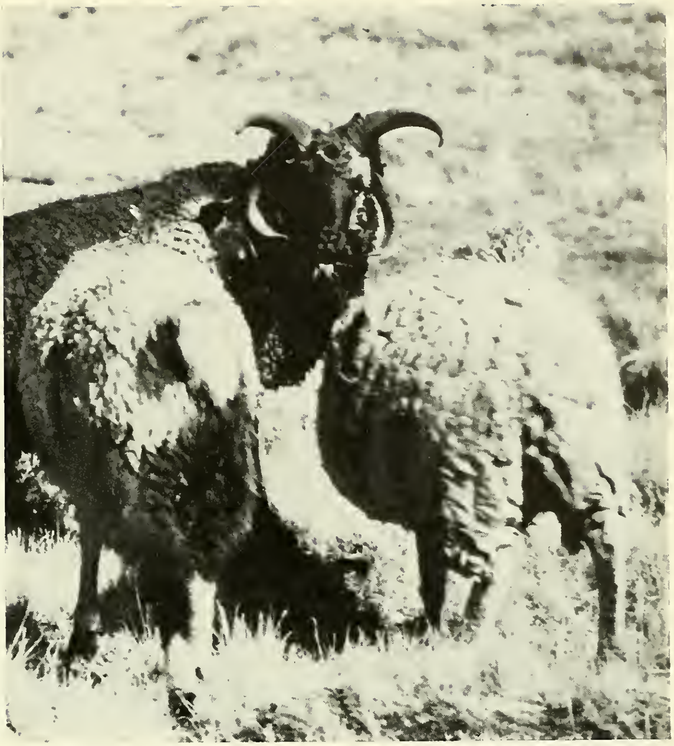
Four-horned Sheep in the Andes

SIRS:

Your article on the four-horned rams of the Navajo Indians in NATURAL HISTORY for May mentions that several breeds of these odd-looking animals are known to exist in various other parts of the world. Just for the record, I offer the accompanying photograph of a four-horned sheep, which I took at about 15,000 feet in the Andes of Peru. Folks up there said the four-horned sheep was supposed to have been extinct for several centuries until this one came along.

HARRISON FORMAN

South Salem, N. Y.



Do They Fly by Ear or Eye?

SIRS:

It was with great pleasure that I read Will Barker's all-too-brief article on the flying squirrel (April, 1955). Bob Hines's illustrations were really excellent, even to those absurdly large hind feet that the young must grow into.

This summer a neighbor gave me a bird house that had been taken over by a female flying squirrel with a week-old litter. Since then I have had opportunity to watch the youngsters grow and develop their aerial skill. The maiden flight was only a jump of about a foot or so, but they worked up to flights of fifteen feet, the length of my room. When I had to put the squirrels in a new glass cage, there were dishearteningly long days of adjustment during which they had to learn that they couldn't fly through the glass. This would seem to indicate that flying squirrels depend on their eyesight in gauging the distance of their flight, as Mr. Barker indicated, and not on any ultrasonic echoes as bats do. It is interesting, however, that several small rodents have been demonstrated to emit ultrasonic vocalizations. Many people seem not to be aware of this, and insofar as I know, nothing has been written to prove definitely that these sounds are used only as a means of communication and not as a "radar" system resembling that of the bats. Temporarily blinded laboratory rats, at least, have very recently been shown to follow a maze correctly by means of reflected echoes.

The glass in my cage seemed to show that flying squirrels depend on sight alone, but perhaps further study is needed before this could be flatly stated as fact.

JOSEPH A. DAVIS, JR.

Ithaca, N. Y.

Important Notice

Readers are reminded that NATURAL HISTORY is not published during July and August. Those who expect to be away after September 1, however, and wish to have their September issue sent to a temporary summer address are requested to notify the Circulation Manager. Please give also the date of expected return to permanent address.

An Open Eye

SIR:

In your article on the octopus in the April issue of NATURAL HISTORY, it is stated that the eyes of cephalopods are more highly developed than those of any other invertebrates and that they are remarkably similar to human eyes.

Professor Joseph Thomas Cunningham, an authority on the cephalopods, has stated that the nautilus, the classic cephalopod, has a more simple eye than any other animal of the same bulk and general elaboration or organization. The nautilus has an eye like a kettle drum and in the middle of the drum-membrane there is a tiny hole that leads into the globe of the eye, which is filled with sea water during life. In place of the refracting lens and cornea, Professor Cunningham points out that there is actually an arrangement for forming an image on the principle of the pin-hole camera. The cavity is lined solely with the naked retina, which is bathed by sea water on one surface and receives the fibers of the optic nerve on the other.

Other biologists have stated that the eyes of cephalopods are very highly developed. What is the truth?

PAUL GRISWOLD HOWES

Greenwich, Conn.

The following information is offered by William D. Clarke of the American Museum's Department of Fishes and Aquatic Biology:

The eyes of cephalopods are very highly developed organs and quite equal to those of vertebrates in complexity and function. The chambered nautilus, however, is an exception. This animal has a rather simple eye, which lacks a lens and operates on the principle of the pin-hole camera. The octopus and squid, which are the more common forms of cephalopods living today, have very fine, complexly organized eyes. The cephalopod eye, like the vertebrate eye, has an iris and a pupil. The iris regulates the size of the pupil and thus controls the amount of light entering the eye. Beyond the pupil lies the lens, which focuses the image on the light-sensitive retina. The comparison to the parts of the camera is obvious. One need only watch a squid capturing a fast-moving fish to be convinced that it has excellent vision. These creatures have the highest developed eyes of any of the invertebrates.

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The Magazine of the American Museum of Natural History

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June, 1955 Volume LXIV, No. 6

Nevada Fall, Yosemite ... Cover Photograph
From a color transparency by Josef Muench

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Carbon + Heat + Pressure = *DIAMOND!* Frederick H. Pough 288
After more than a century of frustrating failures, scientists have at last reproduced the world's hardest substance

The Last of the Tlingit Sealers ... Karl W. Kenyon 294
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You will find Natural History Magazine *indexed in* Reader's Guide to Periodical Literature *in your library*

Natural History

THE COVER THIS MONTH

The bright red Snow Plant and the copious flow of Nevada Fall in the background both identify the season as springtime in this extraordinary photograph taken in one of America's favorite wonderlands — Yosemite Park.

The Snow Plant gets its name from the fact that it often thrusts itself into view while the snow is still on the ground. It is a saprophyte, which means that it lives on dead or decaying organic matter. It grows at high elevations in the coniferous woods of California.

Nevada Fall, 594 feet in height, is one of about eight noteworthy cataracts in Yosemite Park. The cascades are formed by streams plunging into Yosemite Valley from the rims of tributary valleys left "hanging" when glacial action and stream erosion cut the main valley deeper.

Other attractions within Yosemite's 1200 square miles are towering peaks, sheer granite cliffs, beautiful lakes, and park-like meadows. The Park also includes three groves of giant Sequoias.

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THE PILTDOWN FORGERY

by J. S. Weiner

214 pp.
Oxford Univ., $3.50

At a Geological Society meeting in London in 1912, Sir Arthur Smith Woodward and Mr. Charles Dawson announced the sensational discovery of a new fossil man. He was named after the village where his remains were discovered and, as Piltdown Man, began a troubled career of more than 40 years. His special significance for students of human evolution rested on the appearance of a highly evolved cranium—not too different from recent man—far earlier in time than anyone previously had been able to demonstrate. On the basis of this, many scholars felt obliged to revise fundamentally their time scale for the evolution of the human species.

There were, however, certain difficulties that were recognized almost at once. The one that stirred up the greatest controversy was the incompatibility of the lower jaw with the rest of the skull, for it was much more primitive than would be expected for so highly developed a cranium. In fact, soon after the announcement, Gerrit Miller declared the jaw to be anthropoid and some specialists continued right up to the last to regard the jaw as of different origin from the cranium and the whole assemblage to be what Weidenreich called "a chimaera."

The extraordinary thing in the light of events is that although Piltdown man cannot be said to have ever won a wholehearted welcome and although his status had been distinctly on the decline in recent years, no one throughout the long controversy had ever suggested that he was a fake. Apparently scientists work in such good faith that it did not occur to them that anyone would have deliberately gone to the trouble of attempting to mislead them. But that is precisely what had happened.

The denouement came with Kenneth Oakley's testing the fossil bones for fluorine content, a new method for determining age. His discovery that the Piltdown remains were of recent origin set off a series of very detailed studies of the bones and teeth, which revealed unequivocal evidence of falsification.

The publication of these results came like a bombshell and was reported around the world. The story of the whole business, from the original "discovery" to the final exposé, is here told by one of the principal investigators. It reads like a detective story. The author is understandingly cautious in charging anyone with the full responsibility of the hoax, but he leaves little room to escape the conclusion that Charles Dawson, the amateur geologist who brought these remains to Smith Woodward in the first instance, was a principal actor in, if not the perpetrator of, the "crime."

HARRY L. SHAPIRO

RETURN TO LAUGHTER

by Elenore Smith Bowen

276 pp.
Harper & Brothers, $3.50

THIS is a book by an anthropologist describing what it is like to live in the midst of a completely strange and alien society. The fact that the author writes under an assumed name and that the African tribe she studied remains anonymous does not in the least detract from the importance of this very revealing piece of autobiography. On the one hand, she felt it necessary to respect the confidences of her informants. On the other (I suspect) she felt it equally necessary to protect herself against the slings and arrows of an outraged anthropological profession. And I don't blame her one bit, because *Return to Laughter* takes some savage swipes at a number of the most sacred tenets of anthropological science.

Many social anthropologists rationalize their investigations of alien peoples on the grounds that the better we understand them, the better we like them. On the basis of her own personal experience—and the reader cannot fail to agree with her—Miss Bowen states categorically: "It is an error to assume that to know is to understand and to understand is to like." The anthropologist staunchly maintains that he views the native scene with objectivity, that he does not become emotionally involved with the people he studies, and that he never, never passes moral judgments. Miss Bowen demonstrates that all this is so much hog-wash, and dares, moreover, to speculate whether these ideals are really desirable even if they could be attained.

This is the first introspective account ever written by an anthropologist, and it is a thoroughly exciting book. I am not familiar with Miss Bowen's scientific contributions, but I doubt whether they exceed this one in importance. I'll bet my bottom dollar that they are not so well written. No monograph ever is.

HARRY TSCHOPIK, JR.

CELLS AND SOCIETIES

- - - - - - - - - - - by J. T. Bonner

234 pp., 46 illus.
Princeton University Press, $4.50

FOOD intake, reproduction, and co-ordination are the most fundamental life processes. While these functions differ remarkably in diverse species of animals and plants, the ends they serve are always the same, namely, a supply of material and energy for growth and movement, the production of similar living units, and the integration of the activities of cells, tissues, or individuals so that each contributes effectively to the successful functioning of the whole. This is the *leitmotiv* of a book that takes the reader into many interesting facets of biology. It is the common meeting ground for discussions of monkey societies, social insects, colonial hydroids, bacteria, slime molds, carnivorous plants, cellular physiology, circulation and reproduction in animals, human societies, and many similar topics.

The author's specialty is morphology, but he is obviously conversant in an impressive variety of biological subjects. Several chapters are devoted to problems of animal behavior. While the facts are accurately and vividly presented, it is clear that in the understanding and interpretation of behavior the author is less secure. He writes about weaver birds that were deprived of nesting material for four generations. When fifth generation birds were given nesting material they wove beautiful nests without faltering. "Clearly," the author concludes, "this elaborate pattern of behavior was inherited." Evidence such as this actually tells us very little concerning the genesis of nest-building behavior. It certainly does not exclude the very likely possibility that the fifth generation fledgling learned certain basic antecedents of nest building through its own early experience in manipulating twigs and similar objects. In fact, a modern analysis of the development of behavior patterns should take into consideration the combination of hereditary, environmental, and experimental factors; not just one or another. To one interested in properly interpreting animal behavior, uncritical evaluations, such as the one illustrated in the above example, represent a serious shortcoming, but in comparison with the total value of the book this is just a minor distraction. *Cells and Societies* is definitely recommended to those who wish to be instructed as well as entertained.

Readers of NATURAL HISTORY may be especially interested in learning that Chapter Four on army ant societies is devoted exclusively to a description of the work of the American Museum's Curator of Animal Behavior, Dr. T. C. Schneirla, who has just returned from another extensive field study of these ants in Panama.

LESTER R. ARONSON

MEN, MICROSCOPES AND LIVING THINGS

- - - - - - - - - by Katherine Shippen

Viking, $3.00
192 pp., 19 illus.

THIS brief but fascinating biological history covers the period from Aristotle to the present. It also includes a discussion of the long road ahead for biological research. This book compares favorably with William Locy's *Biology and Its Makers,* which was published in 1908. Moreover, by including Thomas Hunt Morgan's memorable contributions to genetics as revealed by the fruit fly chromosomes, it carries historical biology a jump ahead.

Katherine Shippen maintains a vigorous, buoyant style, and a sympathetic understanding that would doubtless bring great encouragement to the fathers of biology were they alive to receive it. She even has a kind word for Pliny the Elder, whom most historians condemn as a backslider from the high standards of Aristotle and a herald of the medieval Dark Age of Science.

Katherine Shippen was fortunate indeed to have Anthony Ravielli as her artistic collaborator. His black-and-white illustrations show a technique and an imaginative quality far outranking those of the run-of-mill illustrator. They are valuable not only for their portraiture but also as symbols of the thoughts dominating the scientists under consideration.

The writer heartily recommends this book as a tonic for despairers of human nature and an antidote for intellectual blues.

G. H. CHILDS

THIS IS DINOSAUR

- - - - - Edited by Wallace Stegner

97 pp., 48 illus.
Alfred A. Knopf, $5.00

THIS book is the next best thing to a visit to Dinosaur National Monument. It starts with 40 pages of splendid photographs, many of them in color, of this superbly beautiful but as yet little-known unit of our National Park System. Eight writers have collaborated in producing a text that covers various aspects of the history, natural history, archaeology, and geology of the area.

Wallace Stegner, who edited the volume, opens with an account of the history of the region beginning with the Indians of the Freemont culture who inhabited the area some 1500 years ago. The modern history of the area commenced in 1825 when General W. H. Ashley and his men

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made the first known penetration of the Green River canyons. The role of Major John W. Powell in making the wonders of the area known to the world is covered in detail. It was he more than anyone else who established the present colorful place names to commemorate events in his passage through the Dinosaur's canyons.

Eliot Blackwelder points out that in many ways Dinosaur National Monument tells a more interesting and diverse geological story than the Grand Canyon, partly because of the extensive deformation the rock layers have undergone. The exposed rock beds of the Monument range back over 500 million years to the Pre-Cambrian period, and the Monument tells a fascinating story of the long series of alternating cycles of deposition that piled up over two miles of sediments and erosion that cut today's spectacular canyons.

In a chapter on fauna and flora Olaus Murie and J. W. Penfold report that many species that once occurred in the area are now absent. Fortunately some like the bighorn sheep can be restored once the Park Service is able to free the Monument from what the authors term "unconscionable competition of domestic sheep for the limited forage" – a competition that unfortunately did not stop when the area was declared a National Monument. It may come as news to many that National Monuments like Dinosaur are still being subjected to heavy grazing even though they are part of the National Park System. It is clear that until this grazing is stopped the area will not be able to support a normal quota of wildflowers and wildlife.

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audubon workshop
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Ancient man's occupancy of the area between A.D. 400 and 800 and modern man's adventures in running the Monument's canyons by boat are interestingly described. The book closes with a fine statement on "The National Park Idea" by its publisher, Alfred A. Knopf, who is chairman of the Advisory Board on National Parks.

Richard H. Pough

THOSE OF THE FOREST

------ by Wallace Byron Grange*

Flambeau Publishing Co., Babcock, Wis.
$4.75, 314 pp., 26 line drawings

THIS unusual and extremely fine book tells the story of the boreal forest as it has never been told before. The author's knowledge of the subject is exceptionally broad and all-encompassing. The histories of a succession of snowshoe rabbits form the warp with which are interwoven details of the lives of an incredible number of the other members of the forest community, ranging from the deer and wolves down to the smallest parasites. I know no other book of this kind that shows so well the concept of the forest as a dynamic entity, almost a superorganism, gradually coming into being as a glacial period wanes, changing in detail from season to season, year to year and place to place, healing the wounds of fires and other catastrophies, and yet always maintaining its continuity as something more than the mere sum of its parts.

The very unusual style carries the reader along in an emotional surge, making it difficult to put the book down without finishing it. However, I am afraid that to me the writing seems a bit overdramatic, forced, and too obviously striving for effect. Nor am I entirely happy about the deliberate, complete omission of man and his works. Praiseworthy though this may be from some viewpoints, it, too, is an artificiality in telling of a forest that has evolved since the last glaciation with primitive man as a component of its fauna, and that today is still maintaining its identity despite the forces of civilization.

Despite these really minor criticisms, I think that this is an exceedingly valuable book which should be read by everybody with any interest in natural history. I will almost say that it ought to be read by everybody, for it portrays, graphically and dramatically, most of the facts and correlations of forest and animal conservation. Despite the handicap of its "purty writin'" it will become something of a classic in its field. And the illustrations by Olaus Murie are, needless to say, a pure joy.

Alexander B. Klots

THE PREVALENCE OF PEOPLE

----------- by Marston Bates

Charles Scribner's Sons, $3.95

MARSTON BATES places the genesis of this book precisely on Tuesday, October 26, 1948, when Dr. George K. Strode, Director of the International Health Division of the Rockefeller Foundation, assigned to him as his next job an inquiry into the problems of population. More specifically, Dr. Strode wanted an investigation into the charges that public health activities and the success of medicine in keeping alive an increasing percentage of people were creating serious consequences for society and, according to some students, for human evolution itself.

This is indeed a subject worthy of any pen, but perhaps one that cannot be resolved with the knowledge we have available. Anyway it is not what Professor Bates has chosen to cover in *The Prevalence of People.* He has written instead a résumé of the fundamental factors that control population growth or decline. These are birth, death, and migration. To these must be added another – culture. Since all people—prevalent or sparse—live in and by some culture or other, their activities in the above categories are affected by it and have to be considered in the dynamics of population. Bates has summarized briefly and with a minimum of statistics a vast amount of writing on this subject. He has done it with a certain ease, in what he calls his cocktail manner, but with essential accuracy. It is an excellent primer.

Harry L. Shapiro

THE BOOK OF BEASTS

----------- by T. H. White

G. P. Putnam's Sons, $5.00, 296 pp.

THIS is a translation of a twelfth-century Latin prose bestiary, intended as a serious dissertation on natural history and dealing with mammals, birds, reptiles, fish, plants, et cetera. The medieval bestiaries drew upon ancient sources, added bits from accounts of travelers and otherwise built up a scrap book of the best current thought on the subject. As the reader of this book will discover, a most surprising assortment of fact and curious nonsense is the result. The data have a curiosity value even if one does not go beyond the first impression. Also, there

---

Recipient of John Burroughs Medal, 1955, for this book is a commentary often associated with the description of a particular animal where an analogy with human behavior is set forth and some moralizing follows. Copious footnotes by the author give the basis for unusual or unexpected disclosures in the text.

But there is a rather revealing psychological quirk if one analyzes the nature of the data set forth. Sex predominates and appears to have been the behavior pattern most often distorted, often to absurd lengths. Attributes displeasing to man are given a big play. Dirty, disgusting habits, real or fancied, are given prominence. As is to be expected, the power to harm man is always featured, the gamut running from the known to the mythical. Anthropormorphic rationalization abounds.

Not the least interesting feature of the book is the author's account of how these copies of the bestiary were produced, by dictation to a team of scribes who employed a type of shorthand abbreviation which would puzzle Pitman or Gregg. If the attention of the scribe wandered the recorded history of the beast suffered.

We are told that "the more the reader is amused by the foolishness of Physiologus, the more he is liable to make a fool of himself." This book can not be bolted at a sitting if one is really to get anything from it.

Harold E. Anthony

THE BIRD BOOK

------ by Leon Augustus Hausman

159 pp., 364 bl. & wh. illus., 16 color
Arco Publishing Company, $2.50

AMONG recent writers on American birds, few if any have exceeded Leon Augustus Hausman in quantity of output. This, his latest contribution, shows some indications of having been rather hastily thrown together. The book consists chiefly of a rather hodge-podge selection of birds, each the subject of an illustration and a paragraph of text. The information is not always up to date, and there are some outright errors.

As for the illustrations, perhaps half of them are a selection of photographs, tolerably well reproduced. To supplement the photographs, paintings by Allan Brooks and others have been reproduced in black and white. A presentation in color of 16 of Audubon's paintings is included as a "bonus section," but it merely adds to the number of recent mediocre portrayals of Audubon's masterpieces. The color might better have been used for some of the less-known work of more recent artists, here relegated to black and white. The level of the better recent popular bird books is so high as to make one like this seem, in comparison, rather inadequate.

Dean Amadon

A Casualty in a war he never knew

Robert has paid a price for freedom. Every small boy needs a father to mend his broken toys, to play with him, to see that he has warm clothes and enough to eat. Robert, who is not yet four, has none of these. A war 6,500 miles from France, half-forgotten already, took them away from him and left only loneliness and poverty.

Robert cannot even remember the soldier father who fought and died in Indo-China. To Robert, "Daddy" is a story-book hero who left to his only son, not his sword and shield, but the War Cross and the Military Medal. When Robert sits astride his broken hobby horse he pretends that *he* is Daddy, riding out to meet the enemy.

Robert lives with his mother, grandmother, and three sisters in a wooden shack on the outskirts of the seaport of Brest, France. The house is damp and cold. There is no running water, no gas, no inside toilet. Robert plays along the muddy pathways or among the garbage cans.

With luck, Robert *may* find someone to mend his broken horse—his only toy. But his mother cannot buy shoes for him—unless someone helps. There will not be enough food to bring color to his pale cheeks, there will not be warm clothing to keep him protected from the bitterness of a Breton winter.

A broken toy, some scraps of ribbon and bits of metal—precious as they are—are not enough. A hero's son—a very small boy—needs help.

HOW YOU CAN HELP ROBERT

You can help Robert or another needy child through the Child Sponsorship plan of Save the Children Federation. For just $120 a year ($10 a month), SCF will send "your" child supplementary food, warm clothing, yard goods, school supplies, and other needed items—delivered in your name in Austria, Finland, France, Western Germany, Greece, Italy, Korea, or Yugoslavia. You may correspond with "your" child and his family, so that your generous material aid becomes part of a larger gift of understanding and friendship.

A contribution in any amount will help.

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● I cannot sponsor a child, but I want to help by giving $..................

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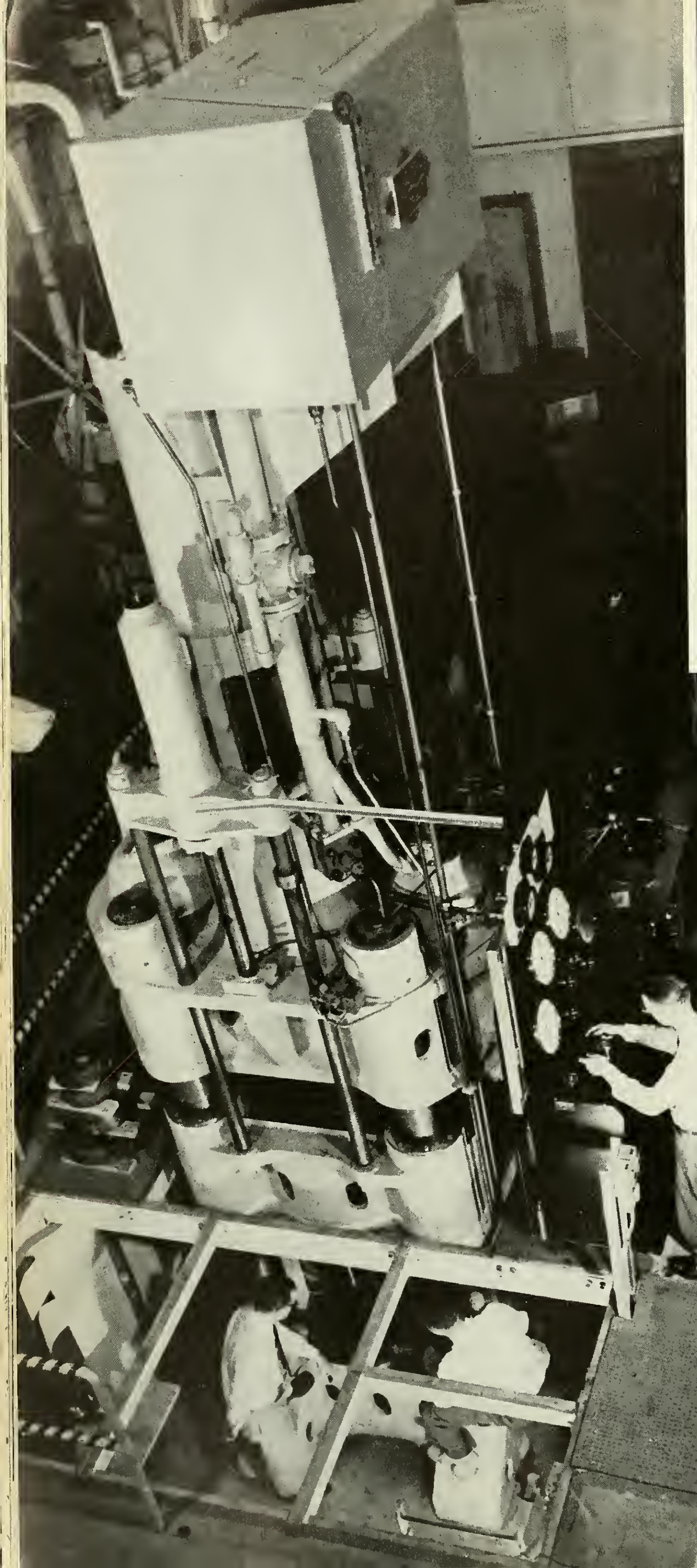
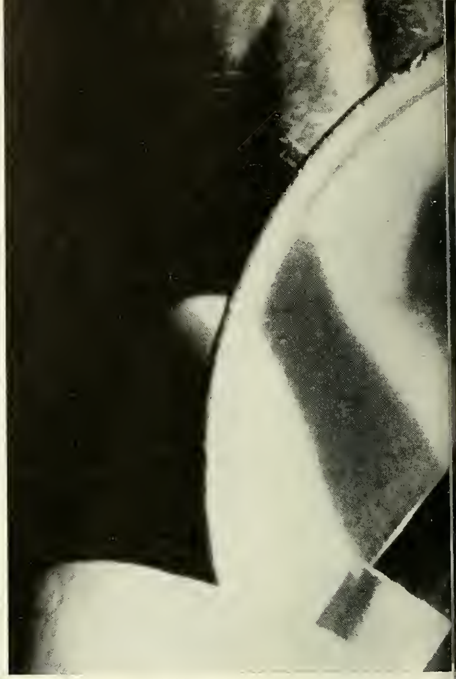
Contributions to the Save the Children Federation are deductible from income tax.

NH-7





◂ MANY YEARS of engineering experi are incorporated in the 1000-ton press produced the first laboratory diam The giant press is several stories

General Electric Research Laboratory

An expert apprai

Carbon

WHEN the General Electric Company announced in February that, at long last, real diamonds had been produced in its laboratories, the psychological reaction was swift and widespread. Though GE emphasized that it had *not* produced gem-sized stones, the news sent brokers hurrying to the floor of the New York Stock Exchange. In a few hours' trading they forced the company's some 86½ million shares of stock up five points, adding more than $432 million to GE's total valuation. Ironically, this short-lived increase was almost 2½

THIS SLIVER of natural diamond actually *exceeds* in ize the largest single man-made crystal. Man's diamonds re still puny beside nature's. At right: a museum model of he world's largest diamond—the Cullinan—3,106 carats.

AMNH photos

riumph of American industry

at + Pressure = Diamond!

After more than a century of frustrating failures, scientists have at last reproduced the world's hardest substance

By FREDERICK H. POUGH

Author of A FIELD GUIDE TO ROCKS AND MINERALS

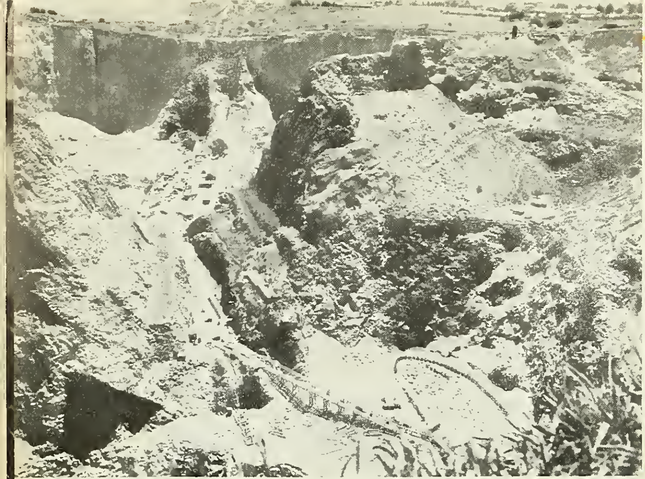
times the value of all rough diamonds sold in 1954.

During the same period, shares in De Beers Consolidated Mines, Ltd., the giant trust that controls diamond production and distribution, lost more than one-fourth of their $130 million total valuation.

This unrealistic situation did not last long, of course, but such is the esteem in which the public holds the diamond. Common sense was restored when word got around that GE's bright new progeny were "industrial diamonds" – not the kind that "are a girl's best friend."

From the standpoint of long range significance, however, GE's accomplishment is indeed a milestone. Full appreciation of it calls for an understanding of the diamond's real importance to our modern society, and for dispelling some of the popular fallacies about the diamond.

For instance, there is the idea that diamonds are rare. The truth is that almost 4½ *tons* of crystals were extracted from the world's diamond mines in 1953. As a matter of fact, diamonds wouldn't be nearly so im-



Africa's Premier Mine (left) is the champion diamon
producer. Miners seldom see diamonds because crysta

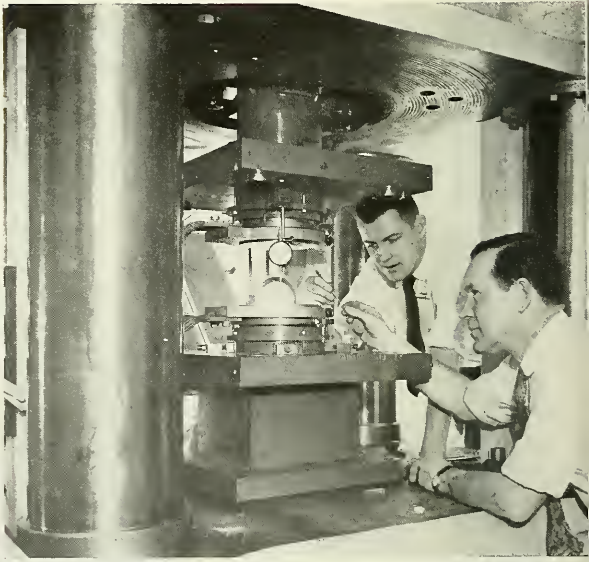
portant if they weren't common in comparison to really rare gems like rubies and emeralds.

Most of the confusion stems from the same sort of thinking that pervaded the stock market last February. It is true that gem diamonds are often extremely valuable and highly prized. It is also true that more money is involved in their sale (about 2½ times as much as for industrial diamonds). But what most people don't realize is that the great bulk of all diamonds are destined for industrial applications. In 1953 more than 12 million carats of industrial diamonds, equal to 5,280 pounds, came into the United States. These were accompanied by a little less than 528 pounds of gem stones. So, in terms of sheer weight of cubicly crystallized carbon, the industrials overbalanced the gems by 1000 per cent.

The U. S. is the world's leading diamond customer. For years we have absorbed three-fourths or more of the world's diamond production. During the two World Wars, our consumption of industrial diamonds grew tremendously, and today much of our precision manufacturing is geared to diamond tools. This expansion has resulted in a more rapid depletion of diamond resources than was anticipated a few

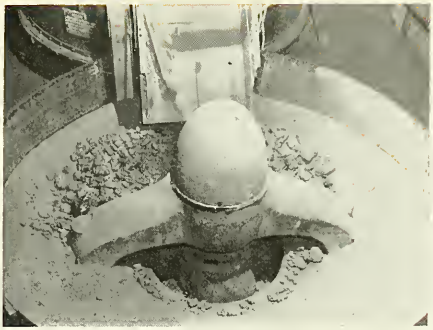
▼ **Henri Moissan**, 1906 Nobel prizewinner and inventor of the electric furnace, was one of the strongest claimants for being first to make diamonds. He is shown below with equipment used in his experiments.

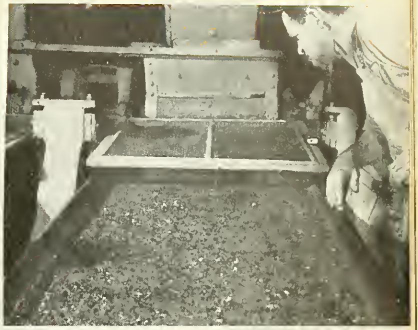
Brown Brothers

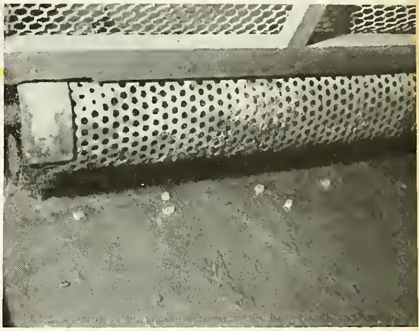


General Electric

▲ **Today's scientists** have much better equipment. Above: two of them at work near the center of GE's 1000-ton press.







ɪpear only after the "blue ground" is carried to the surface, crushed, and sluiced
ɪth water on a greasy table. Diamonds remain unwet and cling to the grease.

years ago. In fact, many of the great South African mines have reached such depths that their productivity cannot continue too much longer.

As is true of all our mineral resources, the diamond supply *is* exhaustible. Some day we must expect higher costs and shrinking reserves. From this standpoint, GE's successful experiment is extremely important.

Durable champion

At present there seems to be no substitute for the diamond in industry. Its great virtue is hardness. Diamond fire and diamond brilliance are now wholly secondary considerations. New gem materials like titania and others yet to come exceed the diamond in these qualities. But diamond durability — the practical reflection of hardness—has not been rivaled. The diamond is the hardest substance known to man.

Hardness is absolutely essential in industrial applications, and it is also important in a gemstone's value. That is one reason why glass, which is relatively soft, is so unsatisfactory even for costume jewelry.

To obtain this hardness in less expensive stones that still possess the beauty of fine gems, man has turned to reproducing nature's efforts in the laboratory. Thus we have synthetic corundum (rubies and sapphires) in place of glass, and synthetic spinel in place of glass imitations of aquamarine and tourmaline. There are many others. Chemists have been investigating laboratory reproductions of natural stones ever since they acquired the technical skill and knowledge that made it seem possible. But till now diamonds have remained out of reach.

To reproduce some minerals, like rubies and sapphires, it is necessary only to melt the raw materials. Crystallized gems will appear on cooling. Others require more complicated "cookery" and varying amounts of pressure — perhaps a "few atmospheres" as the chemist puts it.

But the conditions necessary to make diamonds have eluded technicians for decades. Calculations indicated that pressures greater than 300 tons to the square inch would be required to push carbon atoms close enough together to crystallize them in the necessary cubic pattern. It was also indicated that a high temperature, somewhere around 1500 degrees F., would be needed.

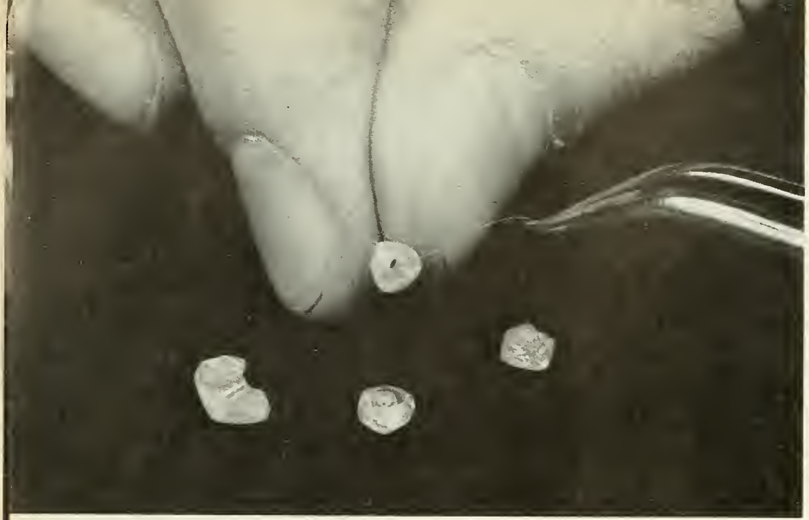
Only in recent years was it possible even to make these calculations. It was known that the matrix in which diamonds are found in the earth is a type of rock that rose, molten, from deep beneath the surface. Also, it was obvious that diamond crystals are much heavier than graphite crystals. So it was only logical to assume that the atoms in diamonds must have been squeezed much more closely together.

So the early experimenters took carbon and squeezed it. The only trouble was that, no matter how hard they squeezed, they ended up with something less than a diamond.

There have been many honest attempts to make diamonds, but these have been greatly outnumbered by false claims of charlatans and promoters. At times it has been difficult to distinguish the genuine research from chicanery. In some instances, sincere investigators have been fooled, or have deluded themselves into the belief that they were successful.

From the year 1823 to the present, there has been a steady stream of reported attempts. In this long series, each hopeful claimant was discredited by his successor, who, in turn, was later shown to have been no more successful.

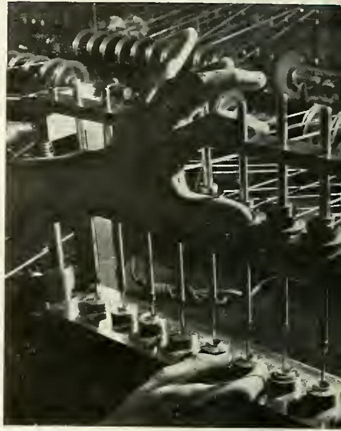
The earliest experimenter who now retains any adherents was J. B. Hannay of Glasgow, Scotland. He published his report in 1880. His



AMNH

◄ GEM-QUALITY crystals are used for wire-drawing dies. Tiny holes reduce the diameter of the wire as it is drawn through them.

▼ A MACHINE for making diamond dies. Minute holes are drilled with hair-thin needles aided by diamond dust as an abrasive.



United Press

system required a steel cylinder 20 inches long, with walls 1¾ inches thick. This was filled with a mixture of oil, paraffin, and lithium. Then it was sealed and heated. Most of his cylinders blew up, but in three that did not, Hannay claimed to have found a smooth black lining of iron and lithium in which were embedded transparent bits of material he claimed were diamonds. They were supposed to have been confirmed by the primitive methods then in use. The controversy is still going on, but the failure of other workers to duplicate his claims, using the same methods, is surely a bad sign. There seems to have been some question as to his good faith.

Heat and squeeze!

The work of Henri Moissan, a French experimenter, has found wider general acceptance—although not among scientists. Moissan produced his report in 1897. By then it was generally conceded that a *truly* high pressure and temperature combination was necessary for diamond synthesis. Moissan relied on cooling iron to obtain the essential combination. It was known that iron shrank when it cooled, but it was thought to expand shortly before solidifying. Moissan reasoned that if he could dissolve a quantity of carbon in molten iron and then chill the iron suddenly, a solid skin would form around the molten interior. Then, when the inner portion cooled and expanded, the carbon would be subjected to enormous pressure. Today we know that pressures thus obtained would not be nearly enough. Actual experiments have shown that iron treated in this way is rather spongy and gaseous and that any pressure developed is quite negligible. But Moissan, of course, couldn't have known this. He tried various alloys and found that a silver-iron mixture would hold the maximum amount of carbon. The abrupt cooling of the iron without causing an explosion presented a problem. This he tried to solve by letting the molten droplets fall into mercury instead of water. When the droplets became completely solid, he dissolved them in acid, and found a small residue of insoluble material. Some of the grains were hard enough to scratch a ruby. Since the only thing known at that time harder than a ruby was a diamond, it was logical to assume that he had made a diamond. The hard carbides so common in industry today (which will scratch ruby) had not been made. Presumably Moissan actually made iron or silicon carbides. His final test was to burn the tiny crystals in a furnace to see if they would form carbon dioxide gas. They did, and this seemed to bear out the original assumption; but here too he was led into error by the new and previously unknown carbide compounds.

Although Moissan's experiments were accepted as successful at the time, the system was not practical, so the search went on. Continuing with the generally accepted requirements of high pressure and high temperature, Sir William Crookes claimed success for Sir Andrew Noble in 1906, with "diamonds" that Noble produced by exploding gunpowder in a sealed tube. Looking back on the calculations, it seems that the temperatures attained were adequate, but the pressures, only 50 tons to the square inch, were far from what we now know to be essential. Like the others, Crookes claimed the discovery of small diamonds in the residue; and, again, they were probably carbides, or even spinel, which is not as hard.

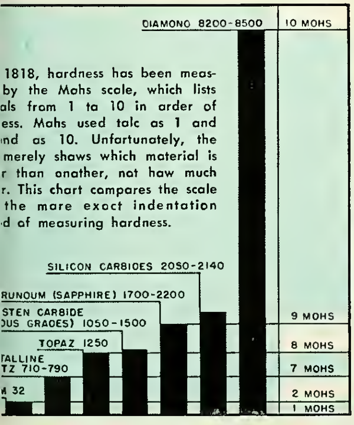
Sir Charles Parsons was the next experimenter. He accepted the Moissan claims, and in 1920, by duplicating Moissan's experiments, also produced stones that he considered diamonds. By 1928, however, he began to doubt the tests that had been used. Eventually he reluctantly came to the conclusion that no diamonds had *ever* been made.

In 1950—about the time General Electric started its work—Professor N. V. Sidgwick stated in a book he wrote that, on the basis of recent calculations of the requirements, no diamonds had ever been made by man.

Unpublished, and still uncertain in outcome, were other experiments. One of these was an interesting thermite device designed to create its own high pressures and temperatures while held in a powerful press. This was invented by Victor Loughheed. In it he placed iron, magnesium, aluminum, and silicon—elements that compose the "blue ground" in which diamonds are formed—as pure powdered metals. Liquid oxygen created the essential thermite reaction (remember the incendiary bombs?), and an electric current triggered the oxidation. This might well have worked, but the experiments were terminated by Mr. Loughheed's death and World War II.

General Electric

▲ THE LARGEST laboratory diamond compared with a phonograph needle. It is said to be thin as paper.



As recently as last year, another distinguished scientist claimed success and showed a few small crystals of microscopic size produced by a somewhat similar process. His device combined heat from electric power sources with a press. It was so arranged that the high temperatures involved would not weaken the metal of the press and reduce the pressure.

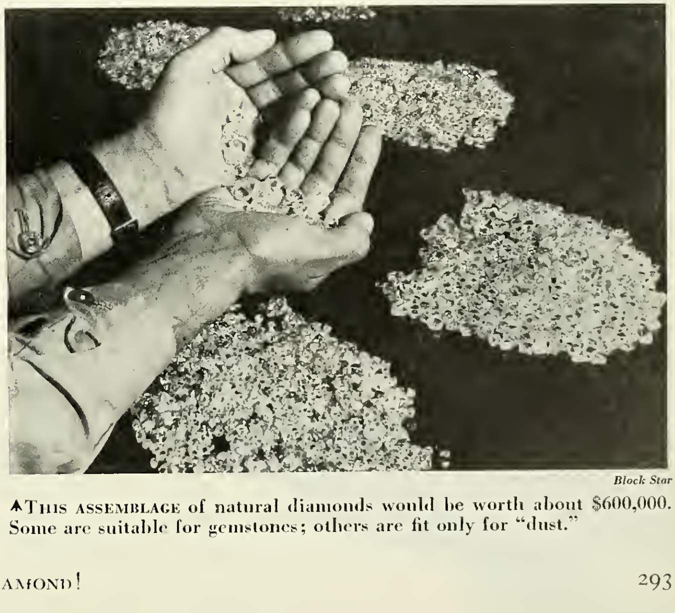
That is the real problem: maintaining heat and pressure over an extended period — long enough for crystals of recognizable size to grow. Enormous pressures are obtainable if the scientists can afford to build big enough presses. High temperatures are also easy to supply. Real ingenuity, however, is needed to combine these two into a usable tool. Obviously, the problem has been solved, even though the product is very small. The eventual developments are still speculative—probably still undreamed of.

The hardness of diamonds, and the need for this quality in industrial tools, is the inducement that spurred General Electric's successful project. GE probably has very little interest in gemstones. If diamonds had only gem value, there would be no justification for the time, money, and brains involved. But GE is one of the largest buyers and users of industrial diamonds.

An alternate source

All U. S. diamonds have had to come from abroad, for America is completely dependent upon imports. Most of them come from the De Beers group of companies. Since World War II, the selling price of these strategic minerals has risen to a point where their cost is a significant item of business expense. It might prove expedient, economically and politically, for us to remove our dependence on this foreign monopoly. Hence, even if we never make a single carat of industrial diamond for actual use, it is vitally important for us to know that it can be done. In the long run, it probably would be wise for us to attempt even larger and better stones in still more giant presses.

continued on page 335



Black Star

▲ THIS ASSEMBLAGE of natural diamonds would be worth about $600,000. Some are suitable for gemstones; others are fit only for "dust."

◂ When commercial sealing threatened the fur seal, an international protective treaty was signed, but the Indians were permitted to continue their ancient hunting. The herds recovered, but ancient ways declined. In the quiet bay at left, the author camped with the Indians and accompanied them on what may have been their last seal hunt.

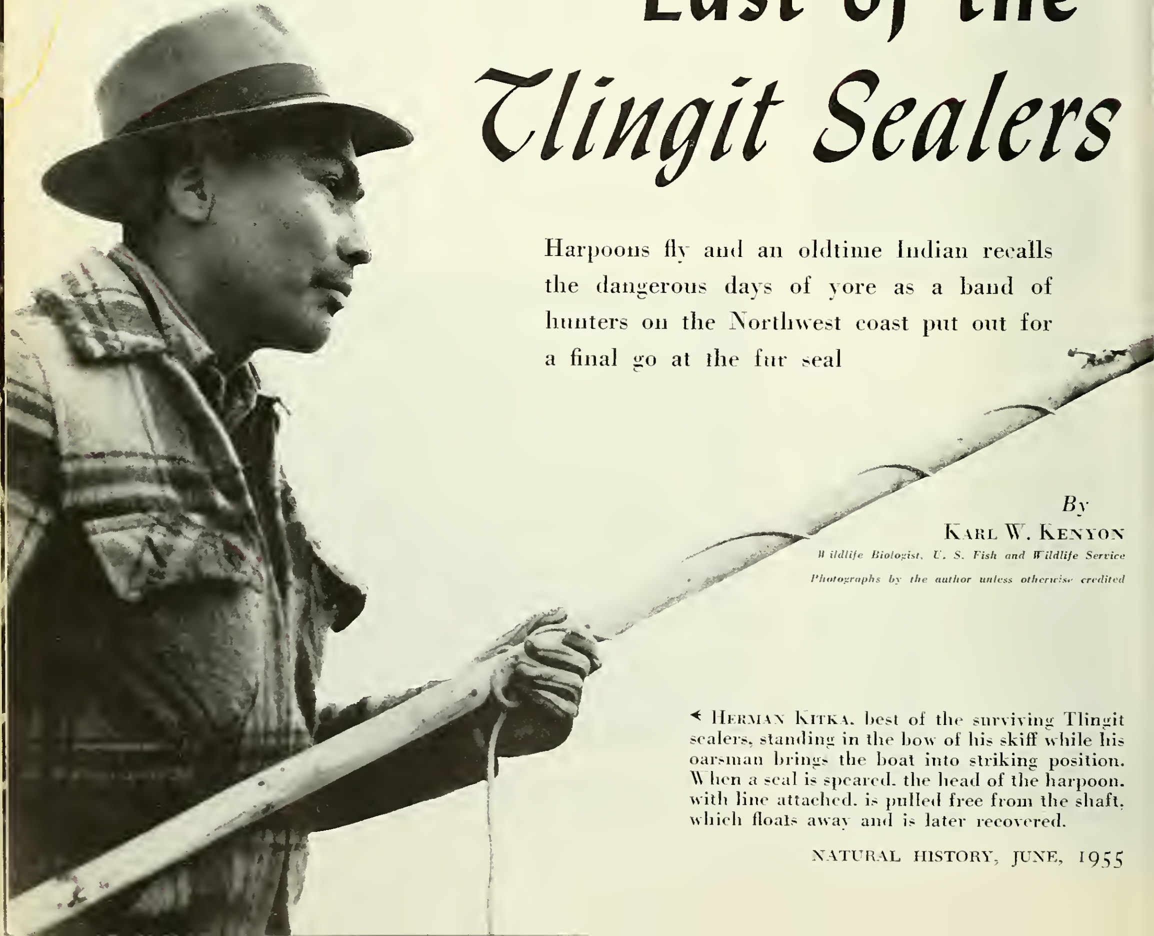
Pribilof Island

Last of the Tlingit Sealers

Harpoons fly and an oldtime Indian recalls the dangerous days of yore as a band of hunters on the Northwest coast put out for a final go at the fur seal

By
Karl W. Kenyon
Wildlife Biologist, U. S. Fish and Wildlife Service

Photographs by the author unless otherwise credited



◂ Herman Kitka, best of the surviving Tlingit sealers, standing in the bow of his skiff while his oarsman brings the boat into striking position. When a seal is speared, the head of the harpoon, with line attached, is pulled free from the shaft, which floats away and is later recovered.

ALASKA
Sitka

Ford Wilke

▲ **FUR SEALS** and gulls feeding on herring in one of the coastal inlets near Sitka. In the foreground, alarmed fur seals "porpoise" away from the approaching sealers. The raised flipper of a resting seal can be seen near the righthand edge.

THE *Martha K.* scraped her mooring on Sitka's waterfront as she bobbed gently on the waves created by a passing salmon troller. Herman Kitka, her owner, a full-blooded Tlingit Indian, "the best of the Tlingit sealers," was tying halibut hooks when I stepped aboard.

"If you want to go sealing with us," he said, in answer to my question, "we can leave day after tomorrow. My father used to like sealing, but most of the younger men don't care about it. This might be the last time I go out. Fishing is more important now, and most of our sealing boats and spears are rotting."

Herman's words bore out reports I had recently read. During the past year, no seals had been taken by Alaska Indians. However, as a wildlife biologist assigned to studies of our fur seal resources, I had come to Sitka hoping that a few seals would be taken so I could add to our knowledge of how the animals live while they are away from the breeding grounds on the Pribilof Islands. We needed to know more about the distribution of different age and sex classes among the migrating seals. And what they eat during their 2000-mile southward migration is of concern to fishermen as well as scientists.

At the appointed hour, Herman had his sealing equipment aboard the *Martha K.* ready to go. Her crew, Cyrus and Lewis, cast off, and we headed south. From Sitka Sound we nosed through a maze of spruce-capped islets bordering the twisting, treacherous 25-mile passage to Crawfish Inlet. There the Tlingits knew that large numbers of fur seals gather each spring.

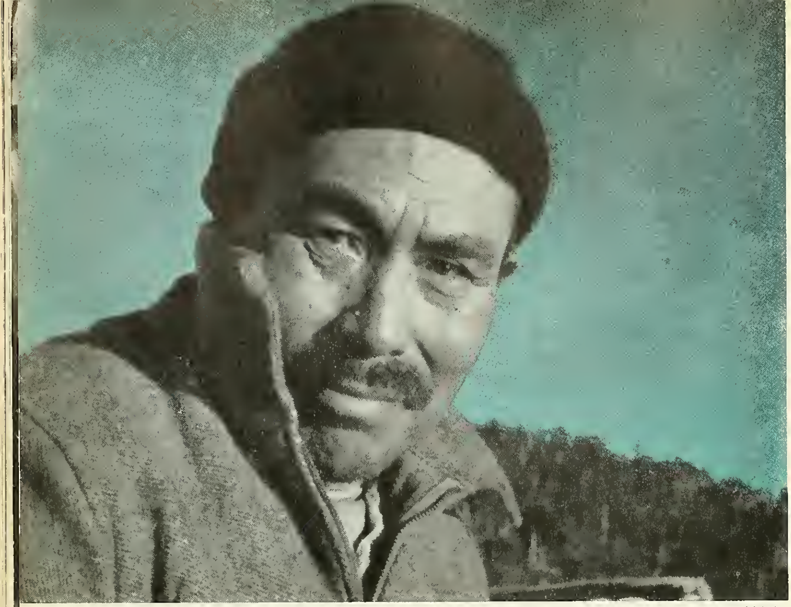
Under international agreement, only the Indians are allowed to harpoon fur seals as they swim northward along the American coast toward their rookeries in Bering Sea. In 1911, after 30 years of intensive sealing, the great fur seal herds of the North Pacific had been all but exterminated. An international fur seal protective treaty was therefore signed by Japan, Great Britain (for Canada), Russia, and the United States. Under this treaty no sealing was permitted at sea except by the few Indian sealers. Today, because of enforced protection, the fur seal herd of the Pribilofs is about as large as it will get under prevailing conditions.

During recent years, scarcely a dozen Indians along the coasts of Alaska, Canada, and Washington have practiced the ancestral sealing technique that I was about to witness. The *Martha K.* crossed the inlet, threaded the narrows, and entered the quiet open water of a hidden bay.

"Here is where we make our sealing camps," said Herman, pointing to a shack nestled among the trees. "My people have used this camp for many years. Even when the wind blows, it is quiet in here, and we can take a short cut out to Crawfish Inlet in our sealing skiff through that little passage over there." He indicated a rift where the sky pushed down among the trees on the north side of the bay.

Herman maneuvered the *Martha K.* to a spot just off the campsite, and soon the last echo of the engine died among the spruce ridges. The vast silence of the Alaska wilderness seemed overpowering. From the sunset glow overhead to distant snowy mountains, there was no sound, no movement. Then the cry of a bald eagle shattered the chill evening air as it left a gnarled snag to join its mate on a more distant perch across the bay. Three white-winged scoters in courtship flight passed low over the water on whistling wings, while in the distance a high-pitched chorus of gulls rose above the hoarse grunts and barks of seals and sea lions as they discovered a new school of herring in the inlet.

After supper we gathered around the fire, and Cyrus, the old-timer in our group, told about early days when he had gone sealing as a



Ford Wilke

▲ **Frank Kitka**, father of Herman, is one of the few remaining Tlingit sealers of the by-gone era. Now he seldom goes sealing.

young man. He was now well along in his sixties, but he remembered clearly the time when sealing was an important activity at Sitka.

"In those days," he said, "there weren't so many seals as there are now, and we had to go many miles out to the blue water to get them. Now there are many, and they come into the inlets where they are easy to get.

"When I was a boy, we went out from our camps on Biorka Island and into the blue waters of the sea. Our canoes were heavy, and five of us would paddle for many hours in calm weather to get out to the sealing grounds. If there was a wind, we could sail. Southeast winds are dangerous, and sometimes one or two sealing boats would not come back. Usually we would go out about 20 or 30 miles. Sometimes we could only see the snow on the top of Mount Edgecumbe from out there. When a southeaster came up, it might take us two days to get back to our camp again.

"If the weather was nice, we would sometimes stay out there all night. We kept a fire in the bow of the boat for cooking. One time when we started out, the air was nice and warm, and I laughed at the old men when they told me to take my coat. That night the southeast wind blew strong for many hours, and we couldn't come in. We were wet with spray and cold. Do you know how I got warm? I wrapped up in sealskins. It was lucky we had killed seals that day."

Cyrus spread his weather-beaten hands near the fire, and as shadows of memories flickered across his face, I recalled some of what I had read of the rapid reduction of the seal herds of the North Pacific. Commercial sealers began their operations about 1869. The adventurous fur hunters who had come north along the Pacific coast had by that time nearly wiped out the more highly prized sea otter, and they turned to the fur seal as the next best source of income. Before Cyrus's time, during the 1880's, open-sea sealing flourished, and the Indians of Sitka were heavily drawn upon, sometimes against their will, to serve as crew members on the sealing schooners that put out from San Francisco.

The ships stopped at Sitka and other Indian villages along the coast to pick up the Indians and their canoes. Eight to eighteen canoes would be put aboard the larger ships and carried out to sea. Once on the sealing grounds, 30 to 80 miles offshore, the canoes, each with a crew of two, set out in different directions. All day they hunted seals with spears and shotguns, then returned to the base ship at night—if they could find it. Seals were killed without regard to sex or age. Many sank before they could be recovered, while others, badly wounded, escaped to die later. A schooner often took more than 1000 skins in a season. Such success prompted the rapid spread of sealing, and by 1892, about 125 American, Japanese, and Canadian sealing schooners were operating in the North Pacific and Bering Sea.

Human tragedy was frequent. Sealing canoes with their crews disappeared in fog and storm. But new sealers took their places, and the damage to the seal herds was devastating. From 1870 to 1900, the sealing fleet took an average of over 100,000 animals a year, the majority females.

Such wholesale slaughter on the open sea, plus the kill on the breeding islands, reduced the Pribilof herd to about 215,000 animals, and by 1911, when the protective treaty was signed, ocean sealing had lost its commercial attractiveness. On the Pribilof Islands, commercial

killing was discontinued until 1918. Since that time the annual harvest has been supervised by the U. S. Government, and the herd has simultaneously yielded a return to the National Treasury and increased to over 1,500,000 animals. The Island kill during the last decade has been from 60,000 to 70,000 skins each year, all young males. The few skins taken in surface hunting by the Indians along the Northwest coast have had no harmful effect.

Stalking

Early the next morning we sailed into the Inlet on our first hunt. Inquisitive fur seals raised their heads to stare at us from a safe distance—then, like playful porpoises, they bounded away. Several groups turned and twisted lazily on the surface, rubbing their sides with their flippers, while others dozed, languidly raising glistening flippers in the early morning light.

Herman stood motionless in the bow, his spear raised, but one of the animals would always hear us before we were within spear range, and with slapping, churning flippers all would flee.

Contrary to popular belief, fur seals on migration do not travel as a compact herd. Instead, they spread out over much of the North Pacific Ocean. It is the exception rather than the rule for them to feed in relatively large numbers as in Crawfish Inlet. Even here, they are often alone or in small groups. Seldom did we see more than ten together. Their behavior in winter is therefore sharply different from that in summer, when they crowd each other for every inch of space on the Pribilof breeding grounds.

After an hour of fruitless stalking, the sealers looked discouraged. "The weather is too still this morning," Herman remarked. "The seals can hear the water lapping on the boat, and it frightens them." In his next statement, the man with the harpoon proved himself to be quite up-to-date. "Sometimes I think their flippers are like radar screens. Have you noticed how they usually wake up when the flipper that is in the air turns in our direction? It will be better when a little breeze comes up. I think the wind and rippling water make a sound in the seals' ears that causes them to sleep so soundly they don't hear the boat."

Even while Herman was speaking, a cat's-paw ruffled the surface near the head of the inlet. Soon, gentle ripples spread evenly over the water. The breeze raised our spirits. "Now we'll get our seals," said Herman, and he motioned Lewis, the oarsman, toward the raised flippers of a sleeping seal.

I noticed that Lewis made a wide sweep, bringing us well upwind of the seal before making a final approach, with the breeze at our back. It seemed to me that the smell and sound of the approaching boat would be carried more easily to the seal from that direction. And when I saw this procedure repeated several times, I asked Herman why he always approached with the wind.

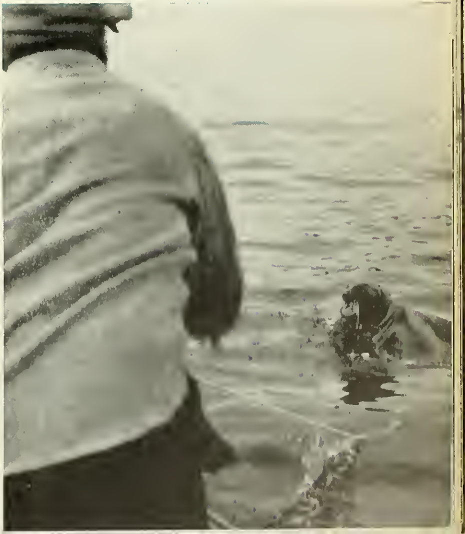
"When you come up on a seal against the wind," Herman explained, "the water slaps on the boat and makes a noise the seal can hear; you also have to row harder, and the oars and oarlocks make more noise. When we drift down to the seal, the wind helps us and we only use the oars a very little. The seals don't hear us unless they are nearly awake anyway."

We slid to within about 30 feet of the seal, but an instant before Herman hurled his harpoon, the animal suddenly raised its head and was gone with a splash. The spear landed harmlessly in its wake.

"Let an old sealer show you how," Cyrus pleaded. He was anxious to match his skill against that of the younger generation. Herman, being the boat owner, felt he should spear the first seal, but since he had missed, he relinquished his weapon and gave his place in the bow to the old-timer.

Within a few minutes we were again drifting noiselessly down on a resting seal. At a distance of about 25 feet, the shaft left Cyrus's hand, and simultaneously the seal took alarm. But his aim was good. The

RUS WILLIAMS, old time Tlingit sealer, hurling the spear at a fur seal that
s sleeping on the surface. The animal awoke just as the spear was thrown,
t Cyrus's aim was good and the seal was captured. The spear is thrown to hit
water short of the animal and glides to its mark just below the water line.
rus began sealing as a boy toward the end of the last century, when sealers
m Canada, Japan, and the U. S. were still operating in the North Pacific.



spear struck the water flat, about two feet short of the seal, but found its mark. Later Cyrus explained that this was the proper way to spear a seal. "The spear will slip along just under the water and hit the animal in the side," he said. "If the spear falls down from above, it is harder to hit a seal."

For an instant, the shaft thrashed at the surface, then it was jerked below, and the carefully coiled quarter-inch line in the bow raced out. In an instant, the 50 feet of line stretched taut in the dark water. The skiff spun half around, and the harpoon shaft, detached from its head, shot into the air. For a few seconds the boat lurched from side to side. Then the line was suddenly slack, and Cyrus began hauling it in, hand over hand, as the seal surfaced 20 feet astern.

At the sight of the boat, black flippers churned the water to foam, and again the line was taut. The seal looked as if it weighed about 80 pounds, and I was surprised at the comparative ease with which Cyrus not only held the line but continued to bring it in. The reason was soon evident. The seal made no organized effort to escape. In a frenzy it dashed first in one direction, then another, sometimes even approaching the boat. Frequently it surfaced, then frantically churned the water and disappeared.

"Be careful when the seal is near the boat," Herman shouted. His warning was hardly spoken when it seemed that a living buzz saw was ripping the planks from beneath our feet. An instant later, flashing teeth grasped the gunwale an inch from my elbow, and a handful of splinters scattered on the turbulent water. Five minutes of wild struggling exhausted the seal. Cyrus now grasped a heavy cedar club and struck the animal a fatal blow on the head.

"It only takes one blow when you hit the seal on top of the head," he panted, as we helped him haul the limp body aboard. When we examined the seal, we found that the spear had penetrated only the web of one hind flipper. "If this one had heard us a second sooner, it would have gone," Lewis observed. Herman had already located the shaft, and as he retrieved it, he motioned Lewis toward another seal.

Aboriginal sealing was conducted in a slightly different way by other Indians along our Pacific Northwest coast. Those at Neah Bay, near the northwest tip of Washington, attached an air-filled sealskin float to the line and tossed it into the water as soon as a seal was struck. While pulling against the float in its struggle to escape, the seal would become exhausted and could easily be brought close to the canoe for capture. Thus, the danger of being bitten by an energetic and angry seal was greatly reduced. Another method was to slide a 20-pound weight down the line, which prevented the seal from surfacing and soon drowned it.

In early days the Indians of the Northwest coast made their harpoon heads of bone or ivory. They were attached to lines of whale sinew, and sinew was used to lash one part to another. When cotton line and iron were introduced by the white man, they rapidly replaced the native materials.

In a week of sealing in Crawfish Inlet, my Indian friends had taken 41 seals, and my barrels were almost full of specimens. Then a southeaster blew up, and the next time we rowed out on the Inlet, the inquisitive dark heads of the fur seals were strangely absent.

"I think the seals have gone to the blue water on their way up north," said Herman. "This is about the time they always leave." So we returned to break camp.

My specimens were hardly on the dock at Sitka before Herman had gotten his halibut gear on deck. "I think my people are fishermen at heart more than sealers—these days anyway," he said. "When old men such as Cyrus and my father are gone, there won't be any more real Tlingit sealers left. Even now, sealing days are over." Herman paused and thought. "If you don't come up next year, we probably won't go sealing at all."

The Firefly

B

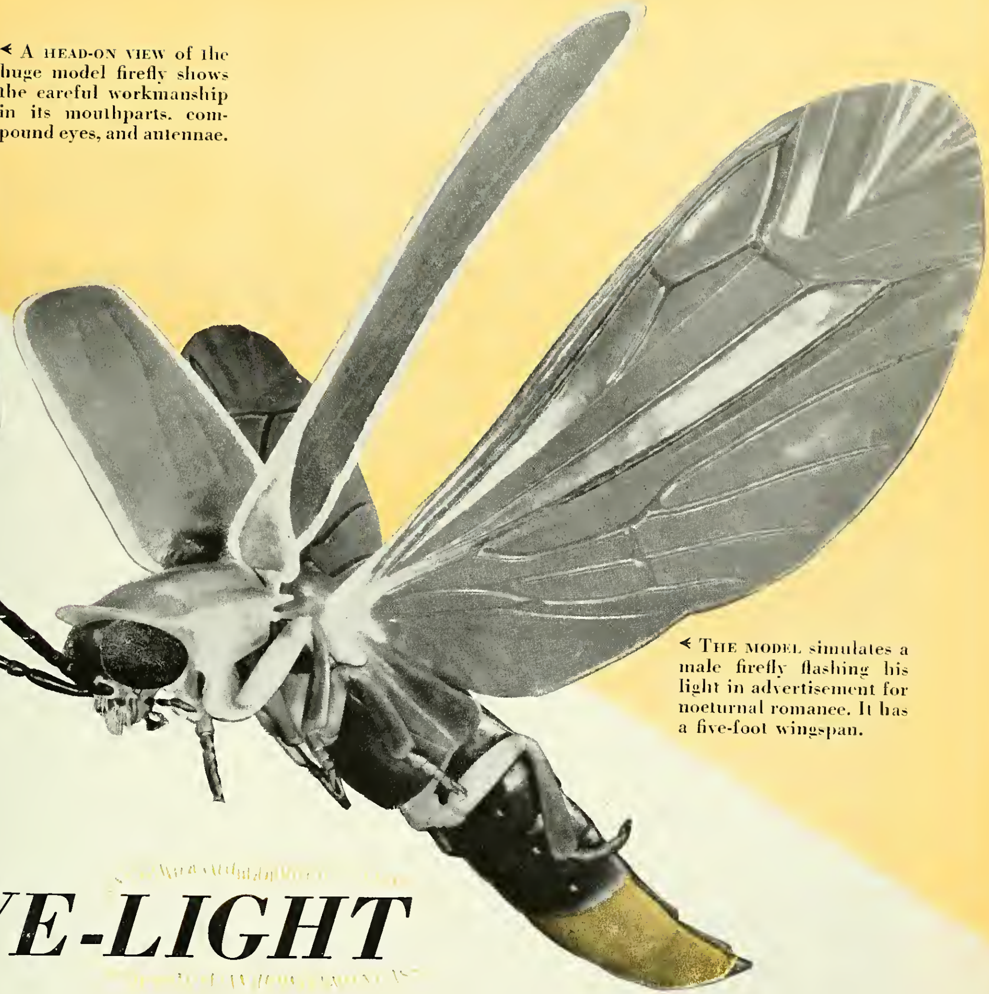
Chris E. Olsen

Photographs by the Boston Museum of Science unless otherwise credited

I HAD made large models of small creatures before, but I did not foresee the problems that would arise with a firefly 64 times natural size. The experience of building this model led to some of the most interesting riddles about insect psychology that I have ever encountered.

The model of a firefly enlarged 64 times would have a wingspread of almost 5 feet and a bulk more than 250,000 times that of a real firefly.

◄ A HEAD-ON VIEW of the huge model firefly shows the careful workmanship in its mouthparts, compound eyes, and antennae.



◄ THE MODEL simulates a male firefly flashing his light in advertisement for nocturnal romance. It has a five-foot wingspan.

OVE-LIGHT

Little-known facts in the mating behavior of one of the world's best-known insects are demonstrated in a gigantic model

The model was to be equipped with an electric flashing apparatus which, together with the internal bracing, necessitated the use of a substantial material. I therefore chose a polyester casting resin, one of the more modern plastic materials, whose tensile strength approaches that of some of our metals. But structural problems were not the most interesting ones. What fascinated me from the start was the insect's behavior with regard to its taillight. It was not generally known before this model was made that the firefly in normal flight lifts its hind legs well above its light, seemingly so its mate will be sure to see its love signal. So far as I know, it was Frank A. McDermott who discovered this, in the course of field studies he had kindly undertaken to help me with my model.

The average person might claim that the firefly was showing "intelligence" by not concealing the signal that attracts its mate. But the serious student of insect behavior would be more apt to deny that the firefly knows what it is doing at all. He would say that for the firefly to carry its legs up out of the way of its light has had survival value down through the ages and that the habit is purely instinctive.

The elements that produce the flashes are mainly oxygen from the air and two substances produced by the insect in its luminous organ, called luciferin and luciferase. The tissues of the luminous organ are penetrated by a network of fine tubes. These are connected directly to breathing holes, or spiracles, situated along the edge of the insect's segments. The latter serve the same purpose as nostrils in higher animals. The firefly has control over the chemical processes in the luminous organs and can turn its light on and off.

Signal system

The insect uses its light signals for attracting the opposite sex. The male flies about signaling, while the female remains perched on low plants in the meadow. When the female sees the male's signal, she responds with a well-timed flash slightly weaker than his.

It would be remarkable enough if only one species of insect had achieved this signal-system. But when you go afield in the evening in June or July and observe acres of meadowland illuminated by the flickering of millions of tiny airborne lights, you are not watching the signals of a single species of firefly but of many different species, all giving out their own individual signals.

Of the 60 or more different species of fireflies in the United States, all those that flash (for there are also nonluminous "fireflies") apparently have developed their own signals, and there is rarely any confusion. Occasionally, a scientist will find a firefly of one species flirting with one of another, but the female usually obeys only the proper signal, ignoring flashes that are timed differently or have a different color. The fact that each species is so delicately attuned probably explains why fireflies are seldom attracted to artificial lights. Only if you imitate the proper color and flash-interval, can you draw a response from a given firefly.

To complicate the matter further, the interval between flashes changes with the temperature. The firefly I was to reproduce was *Photinus pyralis*, a fairly good-sized species found in southern New Jersey, Delaware, Maryland, and southward. Fortunately, I found that Dr. John B. Buck, then of Johns Hopkins University, had published a scientific paper on the signal system and color vision of this particular firefly. He had found that the interval between its flashes was almost twice as long when the temperature was approximately 70 degrees F. as when it was 83 degrees. This would seem to imply that the female must "take the temperature into account" in recognizing her mate. Her responding flash is also modified in the same way. Indeed, the interval between the male's flash and the female's response varies from 2.8 seconds on a cool night to only 1.4 seconds on a warm one.

This variation with temperature is presumably caused simply by physical and chemical factors. But it makes us wonder whether the female's time sense automatically adjusts to take it into account. More observations of the many kinds of fireflies will be necessary in order to know if all of them vary similarly with temperature, and whether one species at one temperature might resemble another species at another.

In giving her response, the female twists her abdomen to throw her light in the direction of the male she has seen, which in a way is just as interesting as the male's habit of carrying his legs up out of the way. Her response-flash immediately excites the male, and he descends toward her, constantly flashing his signal. Presently he meets the maiden *pyralis;* they formally introduce themselves, and in due course become the parents of next year's crop of *Photinus pyralis.*

Considering that everyone is entranced by these mysterious little stars on wings, it is strange that so many wonderful things about them are not generally known. In the model, we wanted to arrange an electrical timing mechanism, so that by pushing a button, the spectator could witness flashes of the various intervals. The instrument could also be made to run continuously through the day. The electrical timing device was built by Thomas Wilfred, Art Institute of Light, West Nyack, New York. It can be concealed under the model or elsewhere and connected by an electric cord to the greenish-yellow electric bulb inside the firefly.

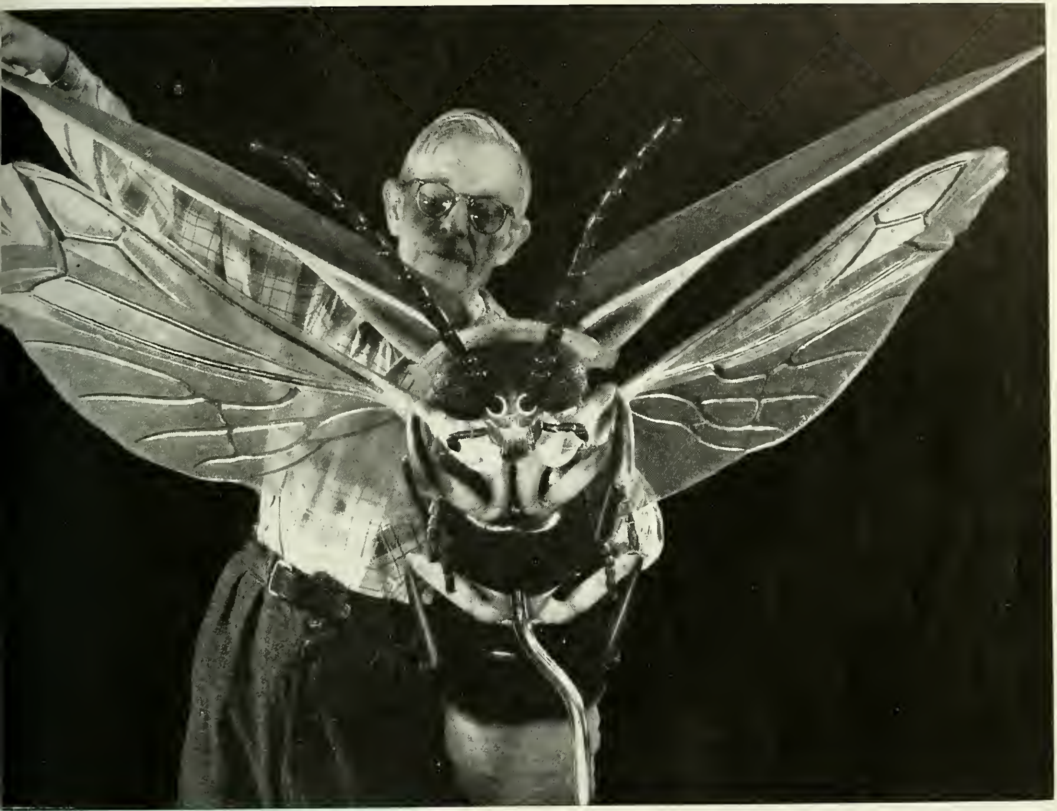
Strange as it may seem, no information was available on the fly-

United Press

▲ AUTHOR-CREATOR Olsen views his finished firefly. Note the insect's retracted rear legs.

ing posture, and I could not make the model until my friend Frank A. McDermott conducted nightly observations with flashlight and magnifying glass. He made many sketches and took a number of photographs of the firefly in flight, using a miniature camera and an ordinary flash gun. As you will see from the illustrations accompanying this article, the correct position of the insect in flight is with the body tilted upward slightly more than 45 degrees. In this position, females some distance away can see the light, not just the ones flying below.

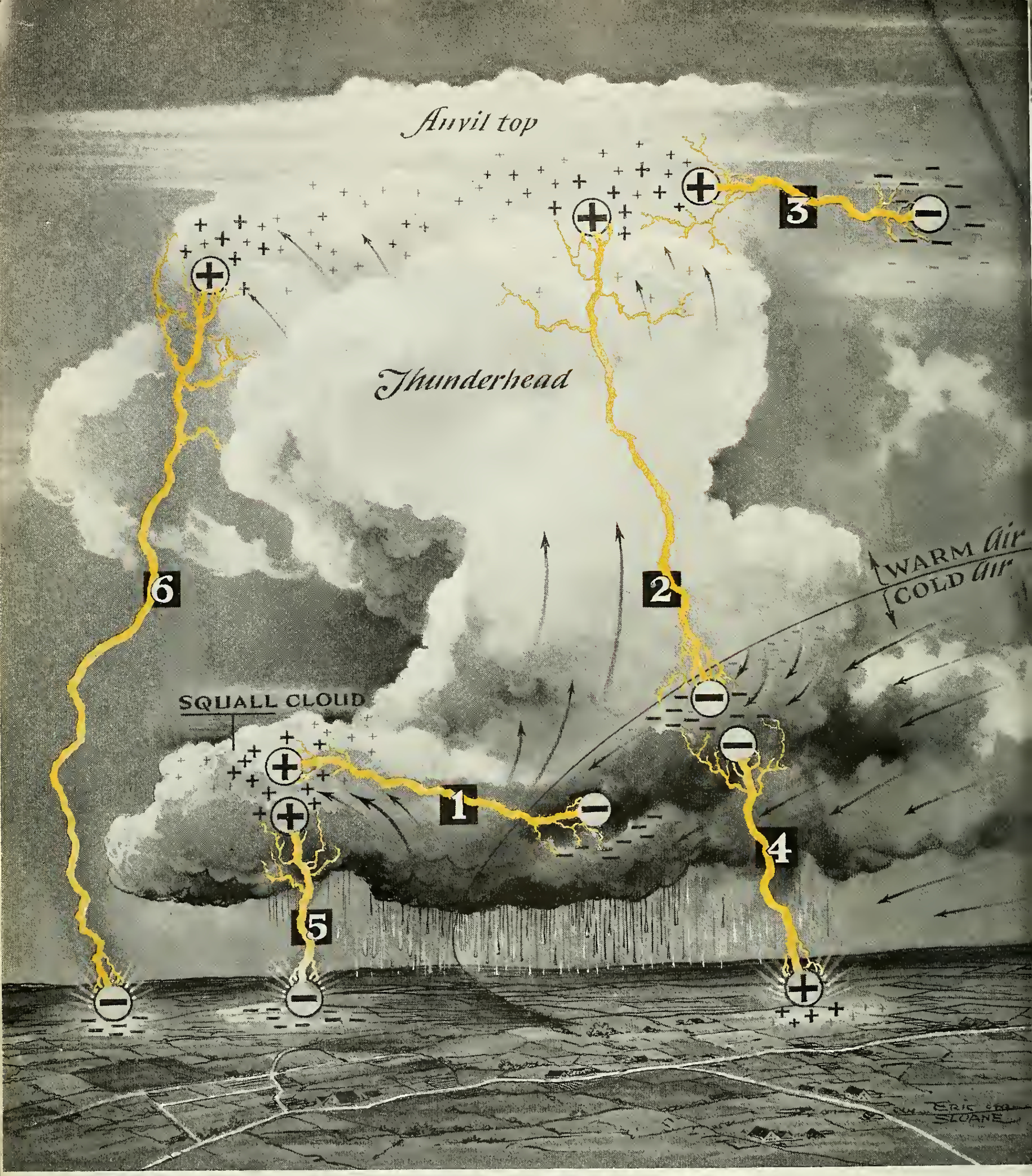
We didn't make a female firefly to keep the giant model company in the Boston Museum of Science where it is exhibited, but perhaps a live firefly will fly in through the window some night and think she has found the answer to a maiden's prayer.



▲ **Mr. Olsen** attaches one of the overlying sheaths that cover a firefly's wings when it is at rest. This is one feature that identifies it as a beetle.

◀ **Inside the model,** below the internal bracing, is a greenish-yellow bulb that produces the intermittent flashes of light.

➤ **"Bug-eyed"** small fry display appropriate wonderment. No milk bottle would be big enough to hold *this* lightning bug.


Anvil top
Thunderhead
3
2
WARM air
COLD air
6
SQUALL CLOUD
1
4
5
ERIC SLOANE

SIX KINDS OF LIGHTNING, numbered according to frequency of occurrence, are shown in this drawing. Arrows indicate movement of air. Updrafts are thought to push positive charges ahead, separating them from the negative charges. After sufficient build-up, lightning, the great equalizer, jumps the gaps.

1. From front of storm to back.
2. From upper clouds to lower clouds.
3. "Glow-discharge" into surrounding air.
4. From low rain-clouds to earth (greatest danger).
5. From "squall cloud" to earth.
6. From upper cloud to earth (infrequent).

Ewing Galloway

Lightning— Public Firebug No. 1

This August alone, lightning will strike about 800 Americans and will start thousands of fires. But you need not be a victim, if you know your enemy

By Gary Webster
Drawings by Eric Sloane

HURRICANES, tidal waves, earthquakes, and floods concentrate their blows in spurts of violence that strike a limited region with dramatic and demonic force. When one of them unleashes nature's fury, headlines scream of destruction and death.

Lightning is more cunning—and infinitely more persistent.

You can live a long and eventful life without being endangered by the natural hazards that make the headlines. But unless you take out a mortgage on an igloo and move the family to the North Pole, you can't get away from searing electrical flashes that dart from thunderclouds.

In the 15 seconds since you started reading this story, at least 750 strokes of lightning have blasted through the atmosphere of our planet. Hammering incessantly at the rate of two billion flashes a year, fire from the sky burns, maims, kills. Because it usually strikes persons one by one rather than in masses, few realize that lightning is the most deadly of natural forces.

Compared with Hurricane Hazel, there's nothing really spectacular about lightning. Only when long-range statistics are compiled does it begin to appear a grimly savage killer.

Day in and day out, lightning kills one person and injures four in the United States. There are no accurate figures for the entire world, but conservative estimates place global totals at 20 times the U S. figure. Taken one day at a time, this makes lightning seem puny and insignificant. But in the half century since Teddy Roosevelt's war record boosted him to the presidency, lightning has killed 20,000 Americans—more men than he commanded at San Juan Hill. The annual toll from heavenly blasts around the world actually exceeds our Iwo Jima losses by more than 50 per cent.

Nine out of every ten American victims are men and boys. Most of them are hunters, sportsmen, fishermen, vacationers, farmers.

When lightning turns its attention to its favorite pastime—setting fires—it stops playing around and settles down to serious business. Amateur standing was lost long ago. Judged by any standards whatever, lightning is easily the

Charles S. Watson, U.S. Weather Bureau

▲ Varied patterns of lightning are shown in this photograph. The exposure was made at night during a thunderstorm over Miami Beach, Florida. Note that each main stroke has numerous branches.

permanent holder of the title, "Public Firebug Number One."

Fire is one of man's most useful servants. At this stage of civilization, it is so easy to get a flame when we need it and where we want it that we forget the centuries-long struggle to make it readily available. Except for fires started by man's agency, lightning is virtually the world's only source of flames. Long before cavemen succeeded in making fire by friction, lightning was adept at setting forests ablaze.

Rural damage still exceeds urban. It is a rare flash that eludes scientific protective devices as did the bolt that blew up a New Jersey powder plant at a cost of a cool $100 million. Most years, sparsely settled areas take the brunt of lightning's attack. Direct cost of the fires lightning starts in the United States alone averages somewhere near $500,000 a week!

Celestial electricity is responsible for more than half of all the fires in the oil industry. It starts farm blazes at a rate estimated to run as high as 30,000 a year. It destroys forests at an average of 1000 fires a month, causing 80 per cent of them in several major national forests.

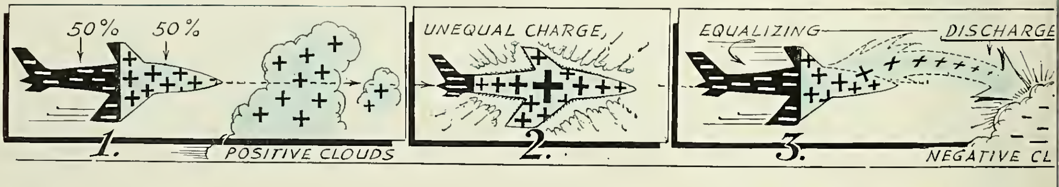
In July, 1940, lightning started 700 fires in a single day—creating an emergency in which 8000 men were mobilized to save timber in Bitterroot, Deerlodge, Kootenai, and Coeur d'Alene National Forests.

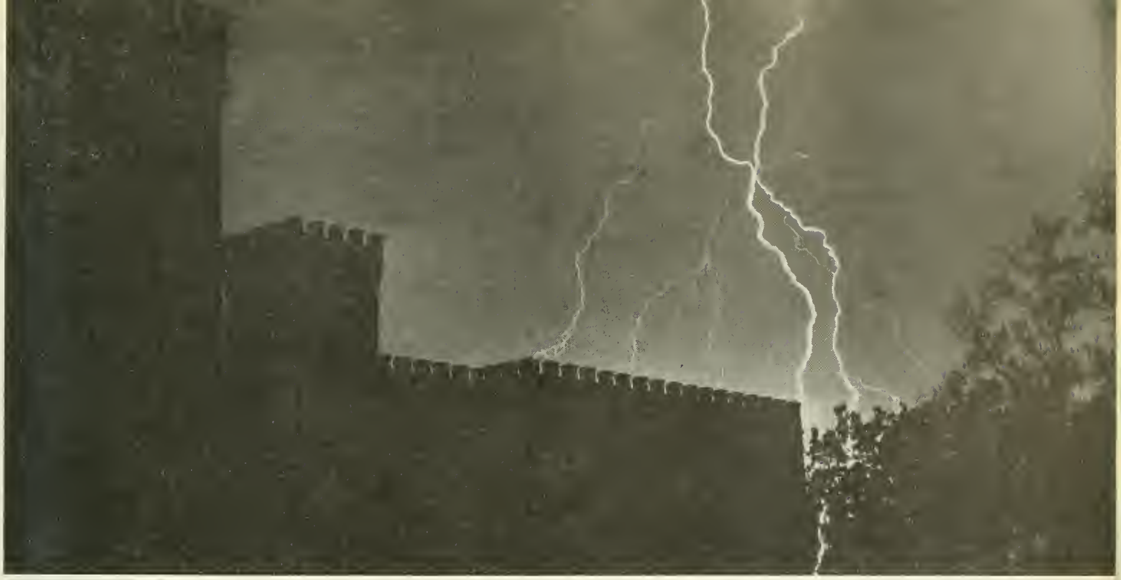
No one knows how many cattle and sheep are killed by lightning, but the number is large. Game fish are sometimes electrocuted in the water, and it is not unusual for food crops to be seared while standing in the field. High-powered atmospheric electricity has struck and burned vegetation ranging from giant oaks to cotton, beets, and even peanuts.

Long-distance power lines get 70,000 bolts each year. Industry spends millions trying to keep the roaring, smashing demon away from installations such as chemical and textile plants, grain mills, and machine shops.

Almost as though with malice aforethought, lightning chooses the peak of the vacation season for its greatest activity, when people are out of doors, exposed. Rocky Mountain and southeastern states get more hits than any other sec-

A PLANE MAKES LIGHTNING: (1) An equally charged airplane flies through a positively charged cloud; (2) the plane becomes positively charged and glows with "St. Elmo's fire"; (3) the plane discharges a bolt into the nearest negatively charged cloud.





Richard M. Paxton

▲ **BLACK LIGHTNING.** The black streaks you see in this picture don't exist in nature. The phenomenon (known as the "Clayden effect") is purely photographic. It is an apparent reversal of photo-chemistry, produced when, during a single exposure, a brief flash of high-intensity light is followed by a diffuse light of weaker intensity.

tion of the country. No area is immune, but thunderstorms are less frequent on the Pacific coast than elsewhere.

Hot weather is lightning weather in most of the nation. Practically all blasts that cause forest fires in the Northwest hit between July 1 and September 10. On any day, it is unusual for a bolt to strike before 10:00 A.M. or after 10:00 P.M. in this section. Records of a 25-year study in Maine show that lightning is rare between October 1 and May 15.

August is the worst month for thunderclouds the country over. Unless electrical storms are unusually sedate this year, August will see about 800 Americans struck by lightning. At least 100 will die.

Fatalities are largely concentrated in areas with populations of 2500 or less. This category includes practically all major vacation spots in the United States, Canada, and Mexico.

Because lightning tends to strike the highest object in a charged field, numerous outdoor activities contribute to its toll. When a blast struck a baseball park at Baker, Florida, three players were killed. Casualties are so numerous on golf courses that the U.S. Golf Association has made a special study of lightning and issues annual warnings to its members.

Bathers beware

There's an old fable that lightning never strikes open water. Many bathers who relied on that belief have lost their lives. In a fantastic coincidence, the beach at Riis Park, New York, was the scene of successive tragedies. Three swimmers were struck and killed one August. Precisely a year later, to the very day and almost the same hour, another blast ripped out of the sky at the same spot. Again three died — and fifteen more were injured.

When lightning strikes a fishing boat, it often kills one occupant but merely stuns the others. In 1951, a flash hit a small vessel in Barnegat Bay, N. J. Running down the steel rod of one fisherman, it jumped to the zipper of his jacket and killed him instantly. His companion was knocked out but had no injuries. Practically the same thing happened at Bridgeport, Alabama, last December. Thomas J. Darnell was killed; his fishing companions were only stunned.

All authorities agree, however, that casualties can be greatly reduced. And except for forest fires, even the incendiary havoc that lightning wreaks can be practically eliminated.

Success in reducing toll from celestial fireworks will come largely from a full understanding of the nature of lightning. Special cameras have cracked many secrets of the sky. Other information has been gained from research in the laboratories of General Electric, Westinghouse, and the U.S. Weather Bureau.

Primitive thought in every land has linked lightning with activity of celestial beings. The Greeks thought of it as flaming spears thrown by Zeus.* American Indians credited it to the Thunderbird, who was believed capable of launching a bolt by winking his eye. Europeans of the Middle Ages weren't exactly sure what demon made lightning but tried to protect their houses by burning sacred logs during thunderstorms.

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*See "The Thunderbolt Belief," by Nels C. Nelson, in NATURAL HISTORY for June, 1947.—ED.

As late as the end of the seventeenth century, even the most learned scientists had only foggy notions about lightning. Dr. John Wallis boldly offered an explanation. It was due, said he, "to an explosion of nitrous and sulphurous vapors in the air"—somewhat like the firing of gunpowder.

Within a decade, a fellow-countryman of the British scholar warned that the theory was inadequate. As a hobby, the Reverend William Wall dabbled with static electricity. He noticed that heavy charges produced both sparks and a crackling sound. So in 1708 he ventured to guess that there might be some link between electricity and lightning.

Half a century later, another investigator attacked the problem. He knew nothing of earlier speculation and devised one of the most daringly original experiments in the history of science. In the very first paper reporting his experimental methods, Benjamin Franklin listed an even dozen arguments that led him to believe lightning a form of electricity.

Beards wagged throughout the learned world. Everywhere it became a fashionable sport to draw sparks from the ends of kite strings. A French magistrate, De Romas, won momentary fame by an exhibition in which he pulled enough electricity from the clouds to cause the current to jump a ten-foot gap.

This charming pastime was generally abandoned after August 6, 1753. On that day a distinguished Dr. Richmann, Fellow of the St. Petersburg Academy of Sciences, was electrocuted in his study. Hoping to secure some of Franklin's celestial electricity, he had equipped his home with an iron rod, which terminated just above his desk. During a violent storm, a globe of bluish fire leaped from his line and killed him on the spot.

How Franklin himself escaped remains a mystery. Weather Bureau scientists, repeating his experiment on cloudless days, received severe shocks a few years ago. Franklin undoubtedly tapped only the gathering charge of a cloud that was working up to a real blast. Had he actually pulled lightning down his string, Philadelphia would have observed a day of mourning and the progress of science might have been delayed for years.

Laboratory lightning

Large-scale study of lightning was not launched until the present century. Ever-increasing electrification made it imperative to guard against interruption of service. Hospitals, industries, even entire cities could be thrown into chaos by a break in transmission lines. So Charles Steinmetz and other pioneers began dreaming of laboratory-made volts. In the winter of 1922, the electrical wizard demonstrated the first lightning generator. Extensions and additions to his apparatus and technique brought potentials into the range of 15 million volts—producing lightning strokes 50 feet long. Using quite different equipment, nature launches bolts that may lash as far as six miles.

Water and air are the basic materials with which a thundercloud builds up a lethal charge of electricity. Air currents and the force of gravity contribute energy to the big natural generator. And the molecular structure of water is thought an essential factor in the process.

According to the theory now generally accepted, clouds build up electric potential by breaking drops of water and by the freezing and melting of crystals. Rising currents carry moisture-laden air high in the sky. There, lower temperature leads to condensation. Raindrops form and fall—inside the cloud. As they plunge earthward, these drops are met by upsurging winds, which break them into fine mist. This, in turn, is carried back toward the top of the cloud to repeat the cycle.* As each drop of water is broken into spray, electric charges accumulate. Additional effects stem from alternate freezing and melting of ice particles.

Buffeted by winds whipping at speeds up to 160 m.p.h., the interior of the thundercloud acts as a giant generator of static electricity. Each droplet contributes only a minute charge. But there are fantastic billions of particles in a cloud three miles high and two to five miles in diameter. No electric phenomena are exhibited by the cloud until nearly ten minutes after radar shows that precipitation is taking place inside it.

Operating according to complex processes that are only vaguely understood, positive electricity concentrates near the top of the cloud. Negative charges build up near the bottom.

Eventually the electric potential becomes so great that the current literally blasts a path for itself

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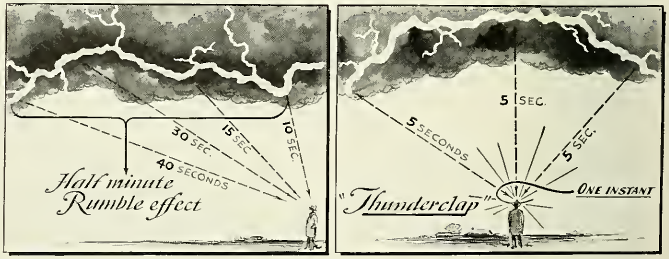
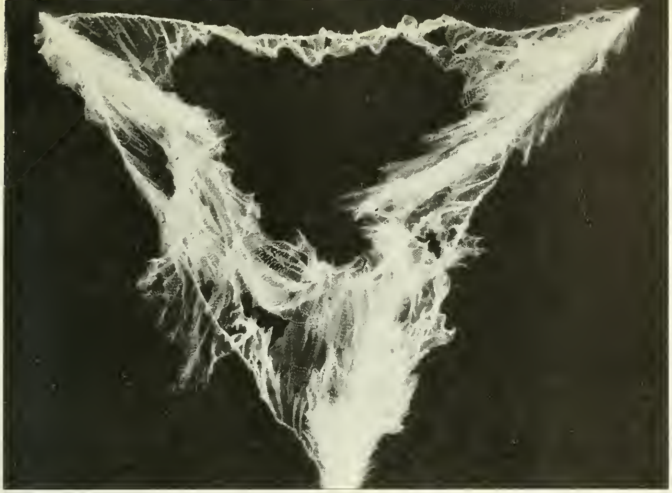
*See "Clouds, Rain, and Picnics," by Harold E. Vokes, in NATURAL HISTORY for June, 1944.—ED.



WHY THUNDER RUMBLES. Though we think of thunder as echoing, the rumbling effect may be heard at sea or on open plains where there are no sound-reflectors. Actually, the prolonged sound is the result of an instantaneous explosion coming from varying distances. The "thunderclap" occurs when a long bolt arches around the listener's head so that all the noise arrives at one instant.



Brown Brothers photos

MAN-MADE LIGHTNING. Basically, scientists produce lightning in the laboratory by imitating nature, i.e., they build up quantities of opposite electrical charges until the difference in potential is great enough to produce an arc of current through the air. A bolt 50 feet in length has been produced.

through the surrounding air. Moving in steps or spurts about 150 feet long, it presses toward the positive electric charge that has been induced on the surface of the ground below the cloud. When contact is made between the two charged fields, electricity flows from cloud to ground. It is this final surge of power that produces both the burst of light and clap of thunder which are earmarks of lightning.

Even in the absence of an actual hit, a charged cloud may induce so great a charge on the ground below that sparks jump from metal objects.

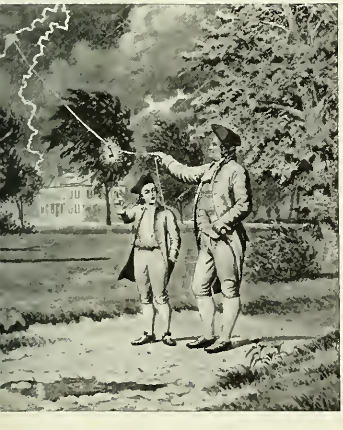
If you need a good second-hand geologist's pick, you might investigate the peak of Great Northern Mountain. Several years ago, a giant thundercloud caught a party of scientists on a field trip up the mountain. Their rifles and tools began emitting sparks visible in broad daylight. So one scholar threw down his pick and ran. To the best of his knowledge, it's still there.

Air as a conductor

Mechanism of the actual flash is extremely complicated. Using high-speed cameras, B. F. J. Schonland tracked bolts in South Africa. He and other researchers agree that a cloud's charge becomes so great it actually transforms the nature of air in the path of a lightning stroke.

Normally a very poor conductor, air in the channel of movement suddenly becomes an excellent conductor. This is believed to be accomplished by ionization—a process through which free electrons are knocked from air particles to form a path suitable for transmission of high-tension electricity.

Brown Brothers



◀ **BENJAMIN FRANKLIN'S** famous (and extremely dangerous) experiment helped establish that lightning is a form of electricity.

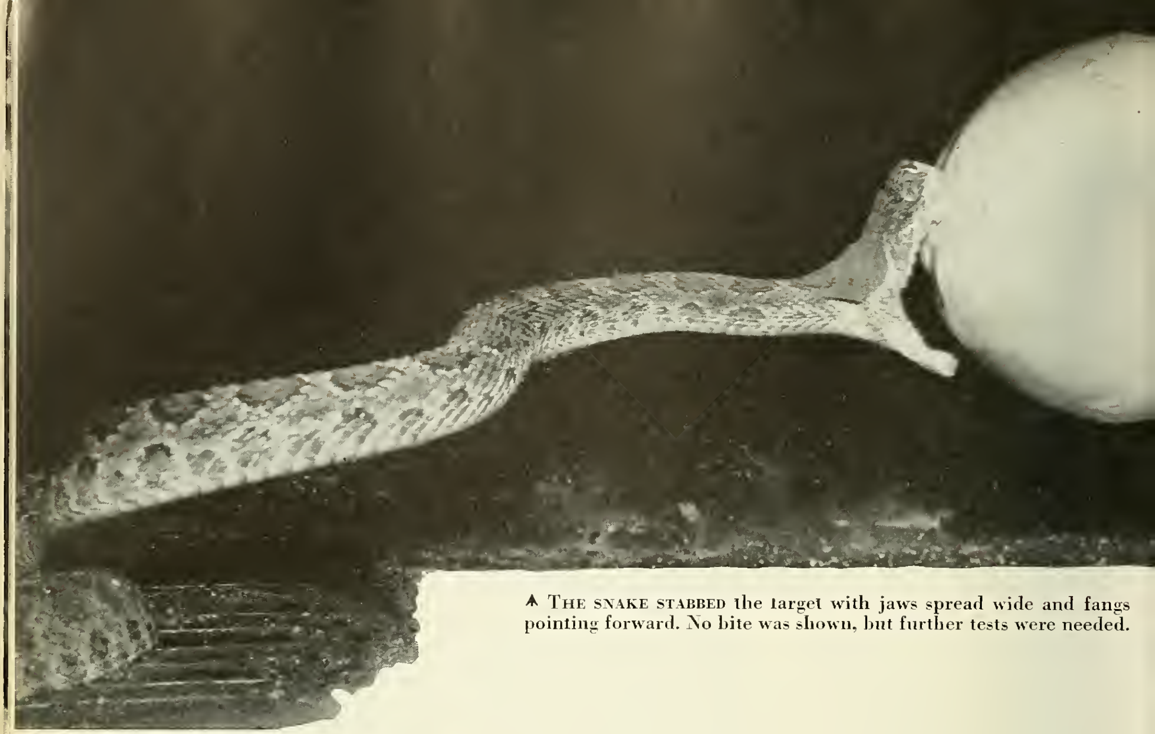
Horace R. Byers, Professor of Meteorology at the University of Chicago, once estimated the speed of lightning at 22 million miles an hour. Others object that this figure is a few million m.p.h. too fast or too slow. Anyway, it moves so fast that the "stroke" seen by the human eye may be formed from as many as 20 back-and-forth surges along a single channel.

Just what produces the flash of light no one knows. Neither oxygen nor nitrogen becomes luminous at any heat that can be produced in the laboratory. But lightning is thought to range as high as 27,000 degrees F.—believed to be considerably above the surface temperature of the sun. This enormous heat, or molecular disturbances in the air, or perhaps a combination of both, causes the flow of celestial electricity to produce lightning's characteristic vivid flash.

Thunder is comparatively simple. As lightning surges through its aerial channel, intense heat causes the surrounding air to expand tremendously. Waves produced by this expansion hit the ear with more violence than the effects from a whole battery of percussion instruments.

Rolling of thunder, which some-

continued on page 332



▲ THE SNAKE STABBED the target with jaws spread wide and fangs pointing forward. No bite was shown, but further tests were needed.

HOW A Rattlesnake Strikes

Superspeed photography and a naturalist's ingenuity clear up three misconceptions that have been current in technical literature and popular thought

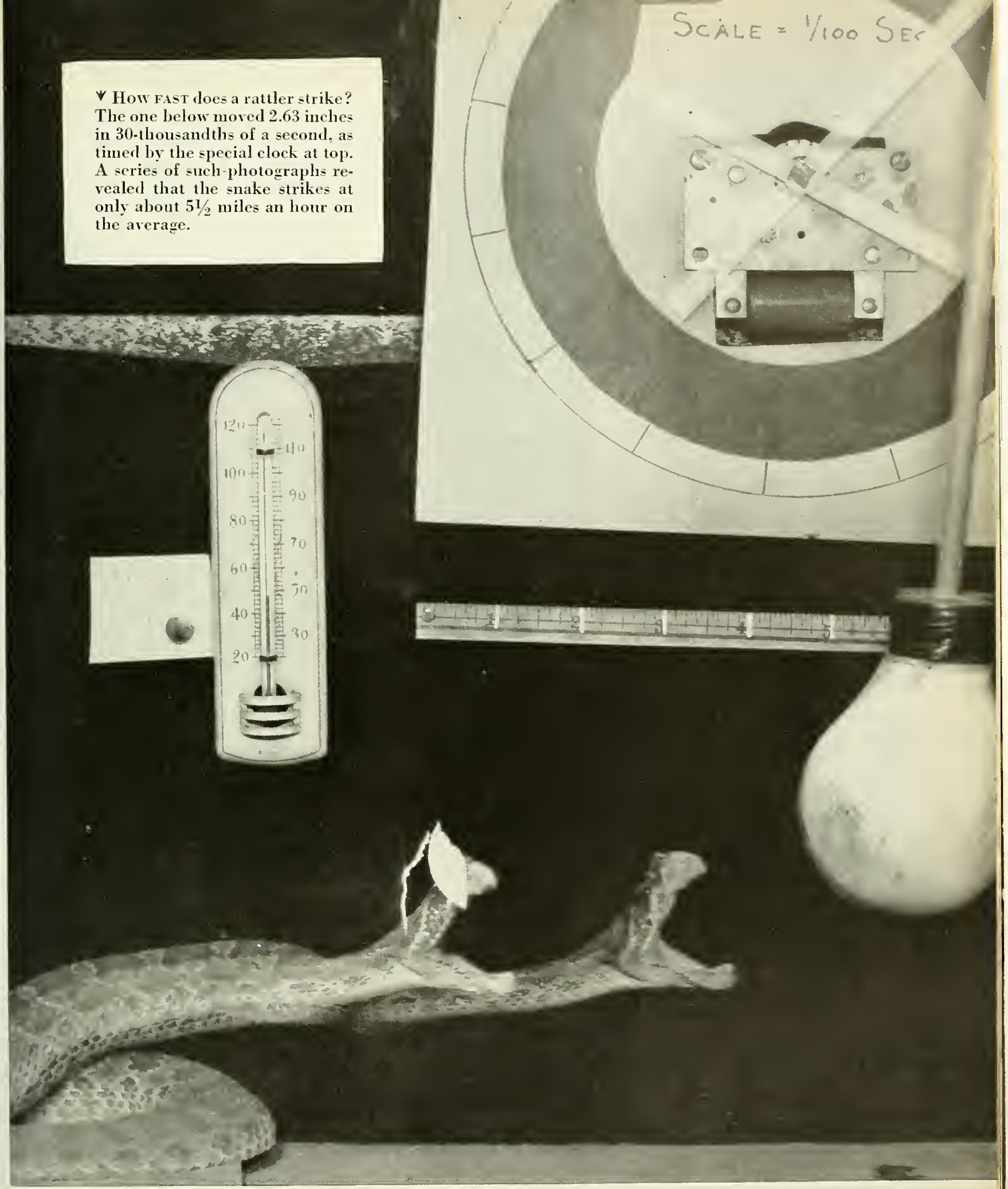
By WALKER VAN RIPER
Denver Museum of Natural History
All photographs by the author

IN both the popular and scientific literature, we are told that when a rattlesnake strikes, it makes a quick bite to embed the fangs and inject the venom. The bite is said to be essential because the swelling and contracting jaw muscles must press against the venom gland and force out the venom. Further, the strike is often spoken of as being "the fastest thing in nature," or "like lightning." There is also a widespread theory that a rattlesnake cannot strike upward. Strangely enough, all these statements are incorrect, at least for the Prairie Rattlesnake.

A number of years ago it occurred to me that the high-speed electronic flash, invented by Dr. H. E. Edgerton of M.I.T., might be a useful new tool for investigating questions of this sort. A series of experiments that I undertook show quite clearly, I think, exactly what does take place when a rattler strikes.

The experiments I conducted during the first two or three years were summarized in NATURAL HISTORY for March, 1950. The snake was shown striking a rubber balloon about eight inches in diameter. The high-speed flash apparatus was so arranged that a picture was taken at the instant the fangs touched the surface of the balloon. The photograph showed a pure stab with jaws fully opened, fangs pointing forward. In order to find out whether the jaws closed in a biting action, a picture was also taken an instant after the collapse of the balloon. No biting action was revealed.

Some of my friends criticized the experiment, however, on the



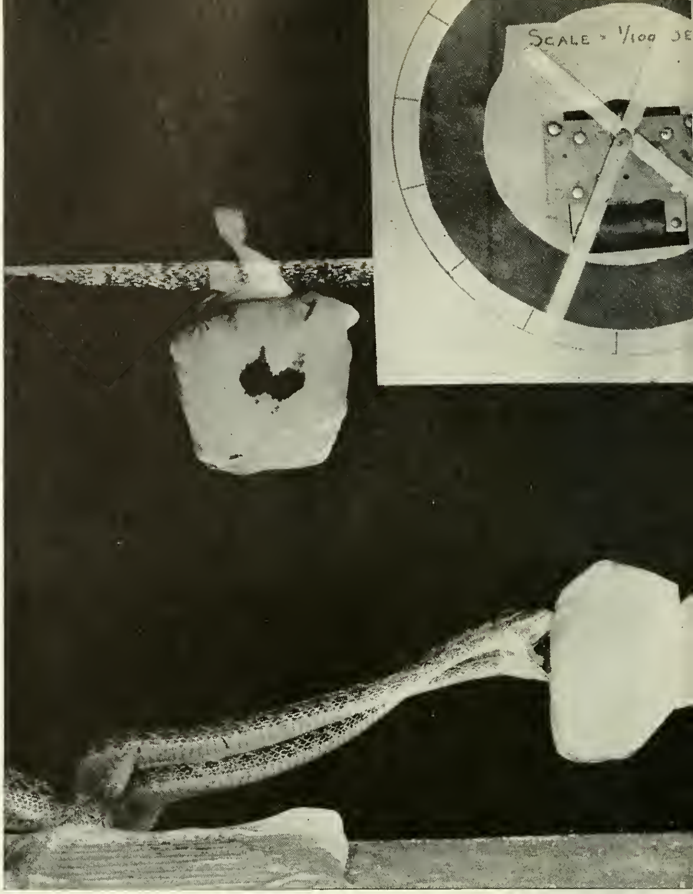
▼ HOW FAST does a rattler strike? The one below moved 2.63 inches in 30-thousandths of a second, as timed by the special clock at top. A series of such photographs revealed that the snake strikes at only about 5½ miles an hour on the average.

grounds that the balloon was an abnormal sort of target. They argued that, since it exploded on contact, it afforded nothing substantial on which the snake could bite. I therefore undertook to devise a more solid target and to invent some way to determine whether the snake needed to bite to eject its venom.

The arrangement shown in the first photograph of this series shows the apparatus used. The target this time was a soft latex ball, three to four inches in diameter, held firmly from behind and designed to be as biteable as any normal prey. The timing was arranged so that the picture would be taken not at the instant of impact but *after* the fangs had penetrated the ball and made contact with the material within. To ensure this, the flash was made to go off when the snake's fangs penetrated the mineral wool with which the ball was stuffed.

The electrical current actuating the flash is a vital element in Dr. Edgerton's versatile high-speed electronic flash when used in investigations of this sort. The circuit in this case was made to operate through the snake's body by placing one wire under a damp pad of earth. Though the voltage was high (200 to 300 volts), there was not enough amperage to produce any spark or shock. This was important, because no part of the snake's actions (the expelling of the venom, for instance) should be due to electrical stimulation. Actually, you could touch both contacts to your tongue while the circuit was closed without feeling anything.

Many tests with this set-up showed that the normal strike was a pure stab with no biting action. However, several pictures did reveal an unquestionable bite. Whether this resulted from an idiosyncrasy of the individual snake or from hits on the target a little off center, I was unable to determine, because I could test relatively few snakes. But the records of the pure stab were entirely convincing, and they were further backed up by a large series of delayed and multiple exposure photographs which fully revealed the snake's action during the interval after penetration.



▲ THIS DOUBLE EXPOSURE shows the snake's jaws wide open as the fangs penetrate and still open at the beginning of withdrawal 30-thousandths of a second later. Above, two blots of venom on the specially prepared target clearly showed that the snake had ejected its venom without biting action.

How fast the strike?

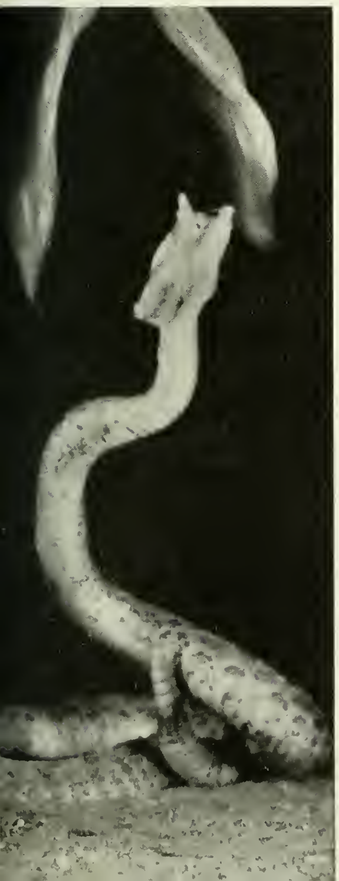
Next, the speed of the strike was investigated, by means of a double-exposure arrangement. In the second photograph, the irregular white spot covering part of the serpent's head is not a blemish but was caused by the light actuating an electric-eye. The snake's head is intercepting the beam at this point and setting off the flash. By means of a relay, two high-speed flashes were set off, one 20- to 30-thousandths of a second after the other. The timer at the upper right of the picture indicated the exact length of the interval between the two flashes.

As seen by the six-inch rule, the head of the snake moved forward toward the target 2.63 inches in the 30-thousandths of a second that elapsed between the two exposures. This gives a velocity of 7.3 feet per second. Out of 20 similar records, 13 fell between 6 and 9 feet per second, and the over-all average was 8.1 feet per second, or 5½ miles per hour. This is certainly not "exceedingly fast." In fact, in comparison with the speed at which a man can move his hands in swinging a golf club or jab with his fist—about 12 to 27 miles per hour and upward—it is very slow.

The third set of experiments had the purpose of determining whether the rattlesnake can expel its venom without biting. The apparatus was basically similar to that used in the demonstration of the stabbing strike. In short, the circuit was closed only when the fangs penetrated the outer envelope of the target and made contact with the material within. The make-up of the target, however, differed, and this is the critical feature of the experiment. It was necessary to know whether any venom touched the target. I therefore used a double sheet of Kleenex, instead of a latex ball, for the outer envelope and treated it with a dye that would react to moisture. Before assembly, the paper was spread out flat and brushed lightly with finely powdered Brilliant Cresyl Blue. This is highly water-soluble. Then the wad of mineral wool was gathered up in the paper and fastened. The target was thus soft, flexible, and eminently biteable. The paper would tear easily and thus register fang and tooth punctures, as well as any tear made by a biting action or by withdrawal of the fangs. And the least drop of moisture coming into contact with the dye would make a dark blot on the paper.

In order to determine whether or not a bite occurred, the flash circuit was arranged to control two picture-taking flashes, one to record the position of the snake's jaws at the moment the fangs penetrated the target and the other a short interval later. The interval between the first and second flashes could be varied so as to study the action thoroughly.

∀ THE RATTLESNAKE has been thought incapable of striking upward, but in this picture one is seen breaking a balloon directly overhead.



After recording the strike with the double exposure just described, the snake and the timer were removed and a third exposure was made with the target held facing the camera so as to record the venom blots.

The composite picture shows, at bottom: (1) the strike at the instant of penetration (body of the snake above and in a straight line); and (2) the position of the jaws 30-thousandths of a second later, body sagging, at the beginning of withdrawal. The exposure at top shows two large blots on the target made by the ejected venom. The two extensions of the blot indicate where the fangs entered and were withdrawn. The two small blots below show where the lower jaw came in contact with the target. There is no evidence of a bite, either in the two exposures of the strike or in any tearing of the paper such as would be made by pressure between the jaws.

By cutting out the two blots and extracting the residue in normal salt solution, it was proved that what dampened the Kleenex was really poison. The solution was injected subcutaneously into the back of a rat by Dr. F. E. D'Amour, University of Denver physiologist. The rat was dead the following morning. A similar procedure using the dye alone did not harm a rat.

Twelve pictures of the latter sort were taken over a period of five days, all of the same snake. They differed only in the interval between the two exposures, which ranged from 12- to 40-thousandths of a second. None of these photographs showed any evidence of a biting action. It may be concluded, therefore, that the Prairie Rattlesnake does not have to bite to expel its venom.

The notion that the striking snake must bite seems first to have been proposed by the celebrated physician Dr. S. Weir Mitchell. Starting in the 1850's, Dr. Mitchell worked for 30 years on the venoms of rattlesnakes and other poisonous serpents. In one of his first papers, he reported that the muscles of the head and jaws, in contracting, apparently brought pressure on the venom gland, forcing the venom forward into the duct of the fang. A biting action, he concluded, was therefore an essential feature of a successful strike. This was repeated almost word for word by Noguchi (*Snake Venoms*, 1909), by Ditmars (*The Reptile Book*, 1907, etc.), by Phisalix (*Animaux Venimeux et Venins*, 1922), and numerous other writers on the subject.

That very handy and versatile tool, Edgerton's high-speed flash, has now shown, it seems to me, exactly what does happen.

While taking these photographs, some additional observations were made. It was shown a number of times that the Prairie Rattler, in spite of folklore to the contrary, can hit a target held directly above it. The last photograph shows this action. The balloon is exploding, and the fragments are visible on either side. Here, the contact points controlling the flash were fastened to the surface of the balloon in such a way that when the balloon collapsed, they closed the circuit.

That the rattler will strike at a warm target much more readily than a cold one was first demonstrated by Noble and Schmidt at the American Museum of Natural History in 1937. They showed that the *pit* of the pit vipers (of which the rattlesnake is one) is a specialized organ for the detection of radiant heat. The inference is that this faculty is of service to the serpent in striking its warm-blooded prey in the dark. In my experiments I made it a practice to warm the target before presenting it to the snake. On several occasions, when I failed to do this, my subjects appeared to strike with reluctance. Warming the target made them eager to strike it.

THE shadow of Baboquivari, the sacred mountain of the ancient people, crept up to the sunny spot where an old man was sitting at the edge of the village above the river. He arose stiffly and winced from rheumatic pain, but in his hand he held the object that had occupied him for many long days. It was done now; he had pecked the last touches and then smoothed the ragged surfaces of this ceremonial stone vessel. In the morning he would present it to the Shaman. The Shaman was all-powerful, the maker of big medicine, and he had commanded the creation of this bowl.

Before shuffling off to his pit house, the old man paused to look toward cone-shaped Cerro Prieto, eternal sentinel of the saguaro country, and southward toward a land that would someday be called Mexico. As he strolled homeward, he gave his work a final critical inspection.

It was good. The stone was rough and dense, a warm creamy gray, with myriads of sparkling black rhyolite crystals. He had hunted far before picking up the rough piece that was exactly right. The shaping had been merely tedious; any good artisan could have done it. But working out the intricate design called for something beyond a craftsman's skill; it was a task for an artist, and the old man was truly an artist.

The bowl was three inches across and two inches high. It would have been a well-proportioned vessel if left plain, but what lifted it above the commonplace was its wonderful design. With consummate skill he had carved, in three-eighths inch relief, a rattlesnake winding in regular curves around the outside. The snake was almost 15 inches long. Its head started near the top of the bowl, and its tail ended close to it at the bottom edge. Five notches at the end of the tail suggested rattles. He had wrought his masterpiece without the use of measurements, by eye and feeling alone. There were no rulers or calipers in the days of the great prehistoric irrigation experts, the Hohokam, who lived in the area for more than 1000 years before the coming of Europeans.

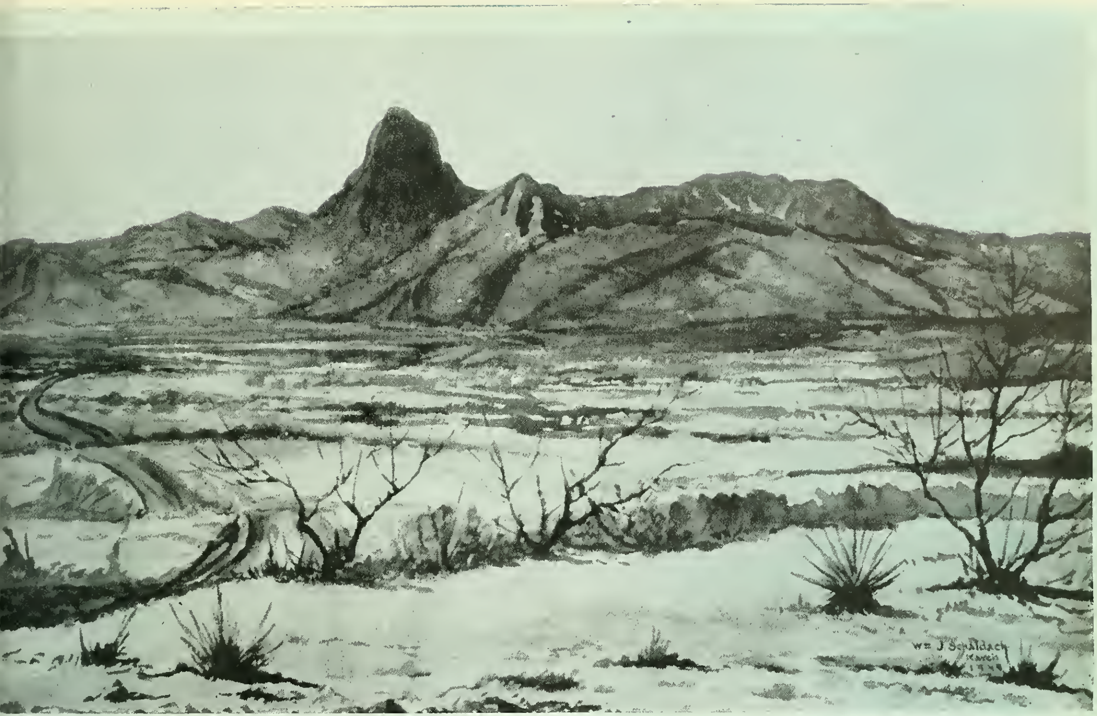
Twilight descended, and many small village fires poked glowing red holes into the curtain of dusk. The pungent fragrance of burning mesquite scented the air. The old man sat cross-legged before his fire and was given food—roasted jack rabbit and corn cakes made from meal ground in a stone metate. The hunters had been lucky; there was also some mule deer and peccary, a small piglike animal that roamed the desert then as now.

He sat by the fire and mused, satisfied with his work. A sickle moon hung low in the western sky, just over the sacred mountain, and the chill of the desert night crept down. Gradually, voices ceased and

Want to

¥ THE AUTHOR and his wife carefully uncovering a large pot on one of their "treasure hunting" jaunts in the Arizona desert.

Ray Manley

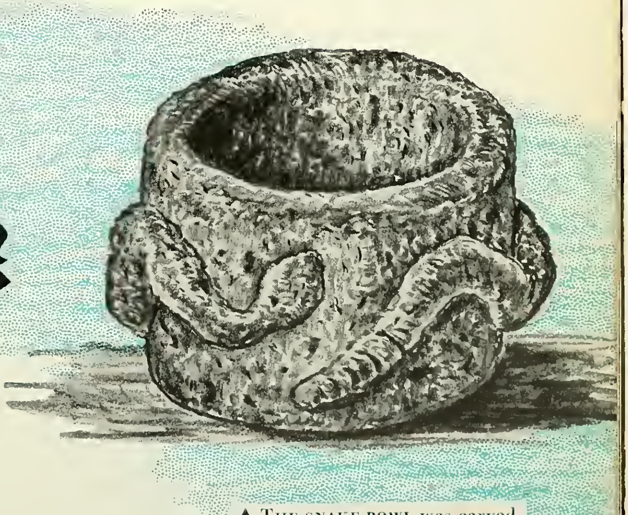


From a painting by William J. Schaldach

▲ THE SACRED MOUNTAIN of the ancient people, Baboquivari, in whose shadows the carved stone bowl below was found.

Collect INDIAN RELICS?

Finding mementos of the
ancient past adds unlimited zest
to outdoor rambling



▲ THE SNAKE BOWL was carved by one of the Hohokam people, probably 1000 to 1300 years ago, in the "Colonial Period."

By WILLIAM J. SCHALDACH

▲ **A FINE GROUP** of petroglyphs on the ranch of Señor Jesus Maria Zapeta (right), who is showing them to the author (seated), Sonora, Mexico.

the village became quiet. The old man retired to his pit house, drew a rabbitskin robe about him, and drifted off to sleep.

Another Day

We found it warm at the site of the old village that October afternoon. The sun was still high enough to light sacred Babo, and we were sitting on a sandy spot, my wife Jo and I, basking in the warmth. After some minutes, Jo's voice roused me suddenly out of a dream mood.

"Well," she said, "are you going to sit there all day, or shall we go out and hunt some more? I'd like to find something myself."

"I still can't believe it," I replied, staring incredulously at the rattlesnake bowl in my hand. "Things like this just don't happen." For years I had been saying, in a kidding way, that I wanted to find a bowl with a rattler carved around it. It would get a place of honor among our prized antiques. We had seen an illustration or two of such things in books on archaeology, but they are rare even in the best collections. And now, darned if I hadn't found one! "I just can't believe it," I said. "I'm afraid I'll wake up. Kick me."

She lunged out playfully, and the toe of her boot caught me squarely on a shin.

"Ouch!" I exclaimed. "I'm awake all right. And I really do have the bowl, don't I? Let's go."

I had run onto this treasure in a wholly unexpected manner. We had worked over the ground of this old village, which we had discovered several years before, without finding anything but a small arrow point and a turquoise inlay piece. We had almost concluded that it was worked out—at least until a gouging rain might uncover something else. Then Jo called to me from a hundred yards away.

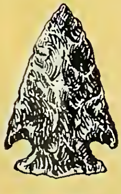
"Come over here," she said. "I just found a fine quartz crystal, and there's sure to be something else around when Ab gives me one of those."

Ab is Jo's special spirit who accompanies her in her searches. When he is in a genial mood, he points out treasures, sometimes things partly concealed. But when the old boy has a mad on, as he frequently does, he lets her down scandalously.

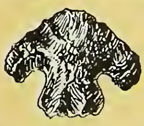
I walked over, scanning the ground as I went. Three-fourths of the way across I stopped suddenly. There on the ground in front of me was a small ring of stone. I called Jo and she ran over. We stared a moment, afraid it would turn out to be a swindle of some sort. It looked so perfect. Then she started to poke at it with her metal-tipped gleaning stick. "Just a minute," I said, "you might scratch it."

The soil was sandy, and I ran a finger around the edge, loosening the earth. The bowl felt lumpy, and I remarked that it must be a crude thing, not carefully ground. When it popped out and I brushed off the dirt, we nearly fell over. "Snake!" we both yelled at the same time, as though we had seen the real thing. But this was much more exciting. There was something weird about this find. It was as if old Ab

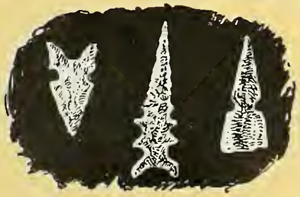
ARROWHEADS from Hohokam village sites.



"Classical" shape, barbed and stemmed. Translucent smoky obsidian.



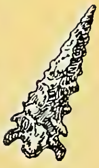
Possibly effigy or "likeness" point. Black pitchstone.



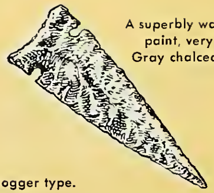
"Swallowtail." White chert.

Elaborate serrote. Opalite.

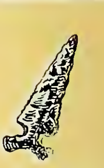
Waisted point. Chalcedony.



Serrated dagger type. Yellow jasper.



A superbly worked point, very thin. Gray chalcedony.

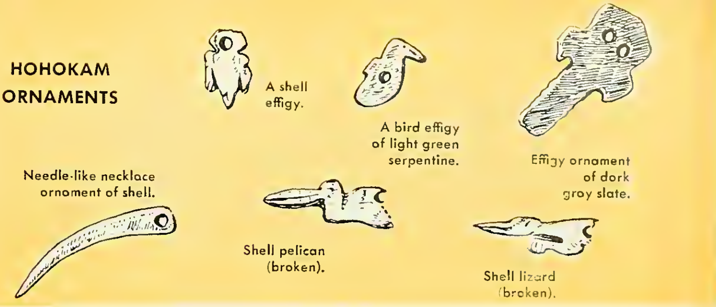


"Fishtail." Translucent smoky obsidian.

himself had read my thoughts and guided me to his treasure.

The avocation to which Jo and I are devoted occupies practically all our spare time. We call it "gleaning," since we search old village sites for whatever may be visible on the surface, or is just coming out. We do not dig or excavate. We are not "pot hunters" and are as opposed to the ruthless and indiscriminate looting of villages as are the archaeologists. We are strictly amateurs, and, so far as our collection is concerned, we wouldn't pay a nickel for the finest point—or sell anything we've found at any price. Furthermore, we know where everything we have came from, so our collection is not a hodgepodge of "Indian curios."

Some artifacts have considerable monetary value, and unfortunately there are many professional hunters who weasel their way through every known ancient site and dig indiscriminately. The fact that this is against the law does not deter them. Items in the "take" are usually sold to curio shops, which in turn vend them at outrageous prices. A good ax may fetch as much as $50. No one knows where it came from, or particularly cares. Much valuable knowledge has been lost forever through this pernicious practice, and I hope that it can be stopped.



HOHOKAM ORNAMENTS

A shell effigy.

A bird effigy of light green serpentine.

Effigy ornament of dark gray slate.

Needle-like necklace ornament of shell.

Shell pelican (broken).

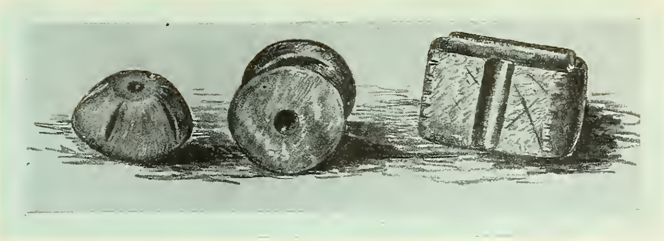
Shell lizard (broken).

Childhood Romance

I first became interested in the ancient peoples of this continent some 40 years ago when, as a lad, I helped a group from the Kent Scientific Museum excavate a couple of Indian mounds south of Grand Rapids, Michigan. We found many wondrous things, among them a ceremonial spear-point of magnificent workmanship, 11 inches long, 2½ inches at the base, and made of many-hued chalcedony. There were copper needles, knives, and axes, obsidian arrow points (the material obviously imported from the West), and even a Florida conch shell. By searching plowed fields, I made quite a collection of points and found a stone ax or two. Then World War I came, and I enlisted. When my term of service was up, I launched out on a session of study and work and forgot about archaeology.

Seven years ago we went to the Border Country of southern Arizona for the winter. We've been going back every year. An artist friend, Stanford Stevens, and his wife showed us some obsidian points and other things they had found, and that started us off. It was slow work at first. One has to become accustomed to looking, especially for small things like beads and pendants, but gradually we became more adept and began to build up a collection. We were joined by Walter Freeman, the Immigration Chief of the Sasabe Port of Entry, and his wife Weston. Johnny Murchison, the Customs Chief, and his

▼ GROOVED AXES and mauls that were once lashed to wooden handles, ceremonial dishes in fine condition, stone mortars, and other objects from Hohokam times form this display.



▲ A POTTERY SPINDLE WHORL for making thread; a pulley-like ornament of deep-green serpentine; and an arrow shaft smoother of gray steatite.

wife Marie also got interested; so did Bill Walls, head cowboy for a huge near-by ranch.

We are a close-knit group, interested not only in finding things but in learning all we can about the ancient people who once roamed the desert, canyons, and mountains of this vast land. The urge for hunting artifacts grows on you like prospector's fever. You never know what will turn up next, or where you are going to find it. Sometimes the richest villages with the "hottest" evidence fall flat and yield nothing; and the dullest spots often give up treasures.

In order to learn all we can about the ancient people, we spend much time reading and asking questions of those who know. For most of what we have learned we are indebted to the writings of the eminent authority on Southwestern archaeology, Dr. Emil Haury of the University of Arizona.

Many of the village sites we hunt over are widely known and have been visited by artifact hunters for many years. Some have been excavated scientifically by museums and other official groups, and abandoned. But each rainstorm brings out a few new pieces, so such grounds are worth revisiting occasionally. Others are more remote and have seldom been hunted. Among these, the best are the ones we discover ourselves, by the process of deduction. Finding a new village is almost as much fun as finding things in it—especially if you have surmised that there ought to be a village there and then find that you have hit it right on the nose!

Deducing where a village ought to be may sound silly, but actually it isn't at all. We have Geological Survey maps of a wide area south of Tucson to the border, east to the Santa Cruz River, and west to the Pozo Verde Mountains. By studying contours along big washes, rivers, and tributary arroyos, we look for the situations that are apt to have possibilities.

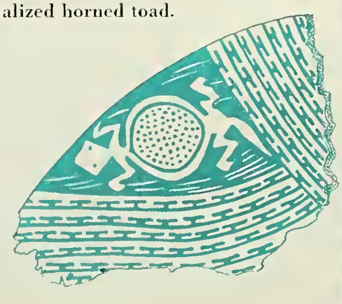
To do this we add what we have learned about the customs of the ancient people. The Hohokam, for example, were largely agriculturists. Practically every village has metates (usually broken or worn through) and the handstones known as manos, used for grinding corn. There are shale hoes and other farming implements, and heavy, thick sherds of pottery which probably came from large storage jars (ollas). The prime requisite, therefore, in establishing the site of a village (not just a temporary camp) is a sizable piece of flat land suitable for farming. Water was necessary then as now; but the fact that there are no streams or springs at present does not necessarily rule out a site, for in Hohokam times the country was much wetter than it is now. A third factor is a good spot for the dwellings, usually one on an eminence commanding a view of the surrounding countryside, where the inhabitants would have warning of a surprise attack.

Sometimes we drive as far as we can go over poor ranch roads, then take out across the desert without benefit of any road at all, and hike four or five miles to the assumed village site. If we are in luck we will find potsherds, grinding stones, chips of obsidian, chalcedony, agate, jasper, chert. If the village had a more elaborate culture, broken shell bracelets, a fragment of a stone ring, or perhaps ornaments of nacre may be found. If we are very lucky, we may find a drawknife scraper, an arrow smoother with a polished groove, a stone ax, or a bowl carved of granite or scoria. Arrowheads may be big utility points used for hunting or warfare, or they may be exquisite little ceremonial pieces of agate, opalite, obsidian, or chalcedony. Often we find beads and pendants of shell, turquoise, steatite, and green serpentine.

Once we have located a good village, we become as cagey about it as horse traders. We all have good

➤ POTTERY is one of the easiest things to find, and it provides a good key to the age of a site. But unbroken bowls are rare.

▼ THE REPTILE MOTIF on one of the pieces might be construed as a conventionalized horned toad.



collections, attractively displayed, and many visitors see them each year. When someone becomes overly curious about the exact location of a particular find, we are apt to point across the desert, in one direction or another, and say, "Why the village is thataway, at the foot of a canyon between two mountains. There's a big saguaro there. You can't miss it." That, of course, covers a lot of ground—especially in Arizona.

It may sound selfish, but we don't think so. We have devoted a lot of time and hard labor to finding a village, and we don't feel that a fellow who isn't even serious should come along and ransack it. We're always afraid that a careless word dropped here or there may bring a deluge of pot hunters collecting for the market. In gleaning remote villages we feel also, that we are doing a good work by saving many fine things that otherwise would go down the drains and arroyos after heavy, sluicing rains. Much of this land is being eroded away at an alarming rate each year, and many more fine artifacts and ornaments have been lost forever than have been found and preserved.

Small Clues

Within our group, which we have playfully dubbed "los Zopilotes" (the Buzzards, in Spanish), information is freely shared. Sometimes this leads to interesting incidents, because in a party of four or five one never knows who is going to come up with a treasure—or under what circumstances.

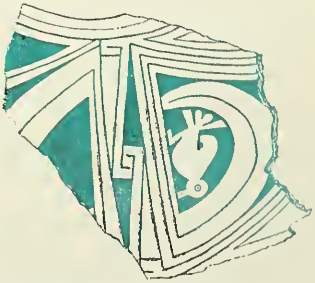
One night a couple of years ago Bill Walls drove over to Sasabe for a visit. "Folks," he said, "I was ridin' range yesterday lookin' for some calves when I found a li'l ol' piece of ground with pottery and chips. Didn't have time to look around much, but I did pick up a nice hunting point. The funny part of it is that this camp is right on the main road to Kinsley's. You've all been by it a thousand times. Don't think there's much in it—the evidence is pretty thin—but you might like to look."

The next day we took off with the Freemans to the place. The evidence certainly was thin: a potsherd every 50 feet or so and a few chips only. It reminded me of a scraggly little village that my amigo, Carlos Escalante, and I had found several years ago. Carlos and his wife own the unique little border village of Sasabe in which my wife and I spend winters, and he is noted for his dry humor. After searching futilely for an hour with no luck at all he had said, "H-m-m. Must have been very poor people lived here." This time the prospects appeared no better. Walt Freeman came up with a broken point of red agate. I found a very crude stone knife. When Walt said, "Well, that's all she wrote," I was about ready to agree with him. Then, as I hopped over a little ditch the rain had made, I thought I saw something sticking out of the side. It was a squared piece of scoria rock, about an inch and a half by an inch, and it barely protruded. We had not seen any other scoria in the village, and it looked suspiciously as if an old Indian had been fiddling with this piece. I started scraping with my gleaning stick and unearthed a curve of stone, then two more curves. Finally loosening the thing, I flopped it out on the surface and emitted a most undignified but appropriate war whoop.

It was a ceremonial stone dish 12½ inches long, 9 inches across at one end, and 4½ at the other. It was beautifully made, with ears at both ends, and in perfect condition. No, we never sell short even the dimmest looking village.

On a later trip to this place, Jo saw an irregular, flat, white granite stone, iron-stained and curved at the edges. It was not unlike dozens of other rocks, but she flopped it over with her stick just to be sure. I was near by and heard her squeal with delight. She had found a fine "free-form" stone dish, carved with loving care ages ago. Of our collection of stone vessels and bowls, just one was found completely out on the surface; the rest showed only a hint of projecting stone. So our motto is: SUSPECT EVERYTHING.

Last year Jo spotted a piece of



▲ THE STYLIZED BIRD on this finely decorated example of Casas Grandes Polychrome was actually made to stand upside down on the pot.

rounded stone not two inches across and dug out a fine polished green diorite ax. And in another village I saw a piece of carved stone no larger than a postage stamp, just like many other insignificant pieces; but it turned out to be about the finest shaft-smoother in our collection. The edges are milled with notches, and the maker incised a big X on one face. His mark? We have another with this same X symbol.

Pottery fascinates us greatly, and we have a considerable collection of decorated sherds with most interesting designs. Unless one excavates, the chances of finding a whole pot are rare, though we have had a little luck here and there. The first time we discovered our "Rattlesnake Bowl Village," we had had a fruitless day up to late afternoon. We had "rim-hopped" a lot of rough country, up and down steep arroyos, and were pretty tired. But a raised flat in the distance looked promising, and we decided to give it a look.

Jo went directly, and I made a loop around. Coming to the head of a small drain, I saw the rim of a buried pot, then another and another. The edges were eroded, and I looked further, hoping to find a perfect one. Then I saw something sticking out of the side of the little gully—the blade of a small green granite ax. It was perfect, and as I lifted it out I called to Jo: "Come over, I've found some buried pots and an ax . . ." I glanced a few feet farther along and there lay another one, an old walloper with a deep groove and polished blade.

"For goodness sake, *please* stop finding things," Jo pleaded, "and give *me* a chance." But this seemed to be my day. The drain contained a remarkable pot with several rows of raised lumps like peas below the rim. Plastered against it where it had been carried by the force of a freshet was a slate palette. Jo later found a magnificent T-end smoky obsidian arrow point and several others of fine quality. One of the plain pots was perfect. As usual it contained only cremated bones. This was one of the best finds we had ever made, and we were very happy. But we couldn't know then that we had missed the best treasure of them all.

A regular gully-gouger of a winter rainstorm came before we could go back to the village again. When the roads dried out, we packed a lunch and were off. At the village, we found several fine points, a couple of turquoise beads, and two shell pendants, one of which was carved with a puzzling design. But when we got to the burial area where we had found the former treasures, we got a shock. On the side of the drain we saw a wonderful decorated pot —or, rather, pots—badly broken and partly washed away. Apparently they had just come out and a cow had stepped on them.

Products of the Storm

We worked to salvage what we could, digging out the main pot and picking up all the available sherds for reconstruction later. We got a great deal of the main pot, but of the cover pot only about a third remained. It had a beautiful linear design and incorporated, besides, four strange reptile motifs which might be construed as horned toads highly conventionalized. I have made a drawing to illustrate this design. We were glad to save this much but regretted not having found it whole the first time.

Another pot fragment, found in a different village, shows a conventionalized bird upside down. The design is in black and red on a fine creamy base, and it must have been a magnificent pot. We found many scattered sherds but could not piece together any more.

When we first started, arrowheads were the chief objects of our search. But we soon built up a good collection of them, and now a point has to be superb before we gloat over it. Beads, pendants, effigies, stone disks and spindle whorls, figurines in stone and clay, shaft smoothers—these are now the most-wanted objects of our searches.

A couple of years ago we ran into an exceedingly elaborate culture in one village and found many fine tubular beads of sea-green stone, beside a spindle whorl-like ornament of the same material. It is the shape of a spool or pulley. It looked so much like jade that we became intrigued. The following spring when we were in New York we took the beads and ornament to Dr. Gordon F. Ekholm of the American Museum of Natural History for an opinion.

"Hm-m-m," said the Doctor, "they look like jade, all right; mind if I scratch one?" He drew a needle across the stone, and a chalky white line appeared. "No," he said, "unfortunately not jade, but still pretty fine. They're probably high-grade serpentine, and hardness is about the only difference."

We keep on trying. The hunt's the thing. There's that white sandstone pestle we found; the carved redstone miniature shaft-smoother with suspension hole that looks Aztecan; a shell pelican and a lizard, unfortunately broken; a shell bird effigy, probably an owl; several finely carved nacre ornaments; two phallic pieces so embarrassingly realistic that modesty forbids our displaying them in the case. Nose plugs, shell needle ornaments, chipped effigy pieces, two of them in the form of a letter H . . . I could go on.

What next? That's what keeps us going, with growing eagerness. It's always the night before Christmas.

Now, as I write, rains have set in; we are more or less housebound for a time, but we dream. We have heard of a remote village with rocks bearing petroglyphs. Potsherds have been found. It will be a hard trip over rough roads. But when the bad weather is over, we'll load the station wagon with camping equipment and be off. Three days, a week, or more — what difference does it make?

In Never-never Land, a turquoise monkey that Jo has been begging for may be waiting; or another fine shaft smoother; or clay figurines and stone effigies. Who knows?

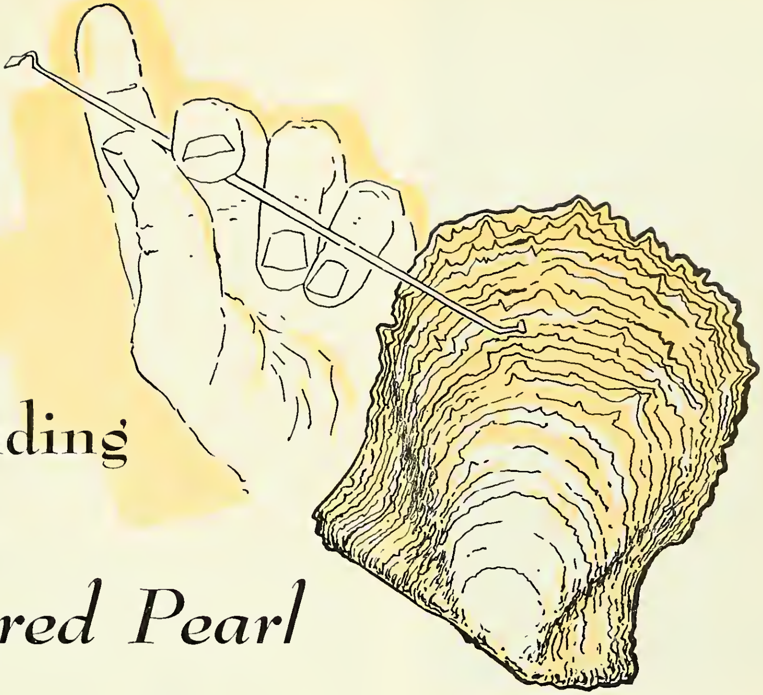
Only old Ab—and he's not telling!

By

LUCIEN L. POHL

Corresponding member, French National Museum of Natural History

Photographs by HARRY B. WRIGHT



understanding the *Cultured Pearl*

How Japanese businessmen put a shellfish to work

ALL too often, the lady examining a necklace of beautifully matched pearls in a jeweler's shop turns away quickly when the clerk tells her that they are "cultured pearls."

"They just can't be the same," is her attitude. They may not be as good, but what she means is that she considers them artificial. Nothing could be farther from the truth. Cultured pearls are no more artificial than tomatoes, corn, silk, or any other of the countless products that man has grown to his own specifications.

Dr. R. Tucker Abbott, in the March issue of NATURAL HISTORY, set forth a brief description of the cultured pearl in his article, "Secrets of the Pearl." I should like to amplify his words, since I have devoted a good portion of my life to the study of pearls—both wild and cultured.

The story rightfully should focus on the man who for years was the central figure of the cultured pearl industry—Kokichi Mikimoto.

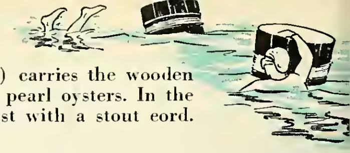
Mikimoto, who died last year, started out as a young noodle dealer in the Japanese fishing village of Toba, near the Bay of Ago. Early in life, he decided to augment his modest income by gathering and selling shells and pearls.

The mollusks that inhabited the shallow waters near his home were true "pearl oysters" (family, Aviculidae; genus, *Meleagrina* or *Pinctada*), and not the common edible oysters, which belong to an entirely different family (Ostreidae). Pearl oysters secrete the bright nacre necessary for truly valuable pearls; the others do not.

Because the shells of the pearl oysters found in his area were too small to yield profitable quantities of mother-of-pearl, Mikimoto would not have done very well if he had not occasionally found valuable pearls. These he usually sold to a European dealer in Yokohama.

After a period of successful trade, pearl-finding became so difficult that Mikimoto found he could not make a decent living. It was then that he began to think of stimulating pearl oysters into producing pearls by inserting artificial devices between the fleshy mantle and the shell. He knew that for centuries the Chinese had used this technique to induce a fresh-water bivalve (*Dipsas plicatus* Leach) into secreting a mother-of-pearl coating over small metallic beads and Buddha figurines. He knew also that the Chinese were only moderately successful. The coating was rather thin; the "blister" pearls were not good enough for jewelry, and the tiny figurines found a market only as simple religious objects or as curios for tourists.

But as a first step, Mikimoto decided to try the Chinese method anyway, so he began putting mother-of-pearl beads between the mantle and shell of his mollusks.



◂ A JAPANESE "AMA" (woman diver) carries the wooden bucket she uses for gathering young pearl oysters. In the water it will be attached to her waist with a stout cord.

This was in 1896. It was not long before he put on the market his first "cultured blisters," or half-pearls (later known as Japanese pearls). To the back of these blisters he added half-spheres of mother-of-pearl so that they could be mounted for display.

These blisters were exhibited at the Paris Universal Fair in 1900 and attracted little attention—which was about what they deserved. Their use to jewelers was limited. They could not be strung into necklaces or chokers, and they had little in common with free "wild" pearls found *inside* the mantle tissues of mollusks. Under the microscope at 90X magnification, their surfaces showed characteristics intermediary to mother-of-pearl and free pearls.

They sold readily enough, though, and provided Mikimoto with funds to continue his research. More than a decade later, during the first World War, he succeeded in producing his first complete "free" cultured pearls. To do this, he put to use quite a different method, a method that is imperfectly understood by many specialists even now. It deserves wider appreciation.

To begin with, it must be understood that not all of the cells in the fleshy mantle are capable of secreting mother-of-pearl. This function is limited to cells on the epithelium of the mantle—those that lie on the outside, next to the shell.

Then how is it that some pearls, specifically the valuable free pearls, are found embedded in the mantle, apparently in the midst of cells incapable of producing them? This is the puzzle that was solved and upon whose solution Mikimoto and his co-workers were eventually to build a great industry.

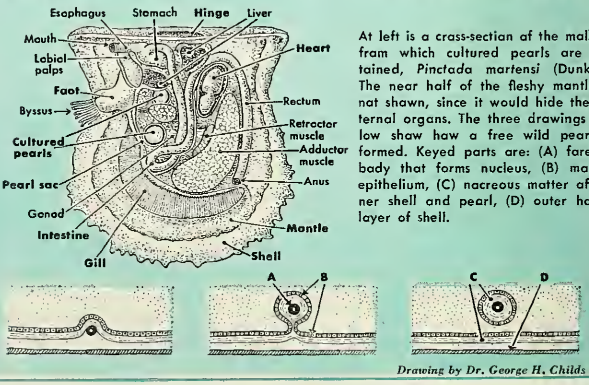
Much of the preliminary work was done by my late master and friend, Professor Louis Boutan, of France. It was he who contributed most to the discovery that a free "wild" pearl is produced only when *epithelial cells* are carried *with* the grain of sand, bit of nacre, or larva of a marine fish parasite as it passes into the interior of the mantle. Here these transplanted cells continue to live, multiply and deposit their lustrous nacre as they would have done had they remained next to the shell. In this process, they become the "pearl sac" that surrounds a free pearl. If the foreign body gains access to the interior tissues without being accompanied by epithelial cells, no pearl is produced. *Therefore, the mere introduction of a foreign body into the mantle will not, by itself, produce a pearl.*

Though this explanation sounds simple when written here, years of patient research were required to work it out.

The Japanese did not overlook this discovery, and Mikimoto, acting on the advice of several competent Japanese biologists, chiefly Professors K. Mitsukuri and M. Miyajima, succeeded in using a grafting operation to produce free, cultured pearls. He transplanted live epithelial cells from one mollusk into the interior tissues of another, sacrificing the one from which he took the living tissue.

This is the key to understanding the cultured pearl. It is true that a round mother-of-pearl bead is generally placed inside the graft at the time of transplanting, but it is not there for the reason you might think. Actually, the epithelial cells would produce a pearl all by themselves, although it rarely happens that way in nature. But because the cells would have no hard core on which to secrete the nacre, such a pearl would probably be misshapen,

INTERNAL ANATOMY OF THE PEARL OYSTER



At left is a cross-section of the mollusk from which cultured pearls are obtained, *Pinctada martensi* (Dunker). The near half of the fleshy mantle is not shown, since it would hide the internal organs. The three drawings below show how a free wild pearl is formed. Keyed parts are: (A) foreign body that forms nucleus, (B) mantle epithelium, (C) nacreous matter of inner shell and pearl, (D) outer horny layer of shell.

Drawing by Dr. George H. Childs

or "baroque" as the pearl dealers say. Mikimoto inserted the bead at the time of transplanting so that the epithelial cells would have a hard, perfectly round core on which to lay down the successive layers of nacre. This method makes possible a greater proportion of large, spherical pearls than would be produced without the bead.

A large supply of pearl oysters is needed, and their rearing is entrusted to agile women divers called *Ama* by the Japanese. The Ama first collect young mollusks from dark areas at the bottom of Ago Bay, where they have passed through several metamorphoses after hatching. The divers then place the pearl oysters in special cages that hang from wooden rafts. Here they are safe from predators. As the mollusks grow and begin to crowd one another, the Ama shift them from time to time to less populous cages.

In about three years, the mollusks are large enough for grafting. They are then removed from their cages and taken to a laboratory on the coast where skilled specialists perform the intricate "operation" in which living epithelial tissue is removed from one oyster, wrapped around a bead, and inserted into the mantle of another.*

Afterward, the live mollusks are put back into the sea in other special cages. Periodically, the workers examine them and clean the cages. In from three to four years, the mollusks produce marketable pearls.

Even in their cages, the pearl oysters are not entirely safe. A sudden drop in the temperature of the water or an invasion by small parasites can take a swift and devastating toll, killing hundreds of thousands of them. Several catastrophies of that kind have occurred since the start of pearl culture, mainly through the influx of billions of microscopic dinoflagellates into Ago Bay as the so-called "Red Current." The color of the water actually is tinted red by their countless forms.

But the industry has always managed to survive these disasters and to continue producing pearls for Madame and Mademoiselle. But let it not be thought that beautiful pearls can now be produced in mass-production style. Many cultured pearls are misshapen, and most of them, like wild pearls, are not truly round. Those of good size, with satisfactory shape, color, luster, and iridescence, and without visible surface imperfections, must still be considered exceptional.

Without doubt, some people will always prefer the wild pearl for reasons having nothing to do with scientific facts. But it is well to remember that the quality of *any* pearl should be judged by an expert.

▲ A TECHNICIAN removes a cultured pearl. Good quality pearls almost ½-inch in diameter have been produced. Rate of growth is influenced by condition of the mollusk, temperature of the water, and other factors. Nuclei introduced may vary from pinhead-size to ¼-inch in diameter, depending chiefly on the size pearl the growers desire.

➤ PERFORATED DISKS are used to sort the pearls by size (smallest size first, largest last). Special paddles with 100 holes each are used to count them. Later the pearls are graded for qualities of roundness, color and luster.

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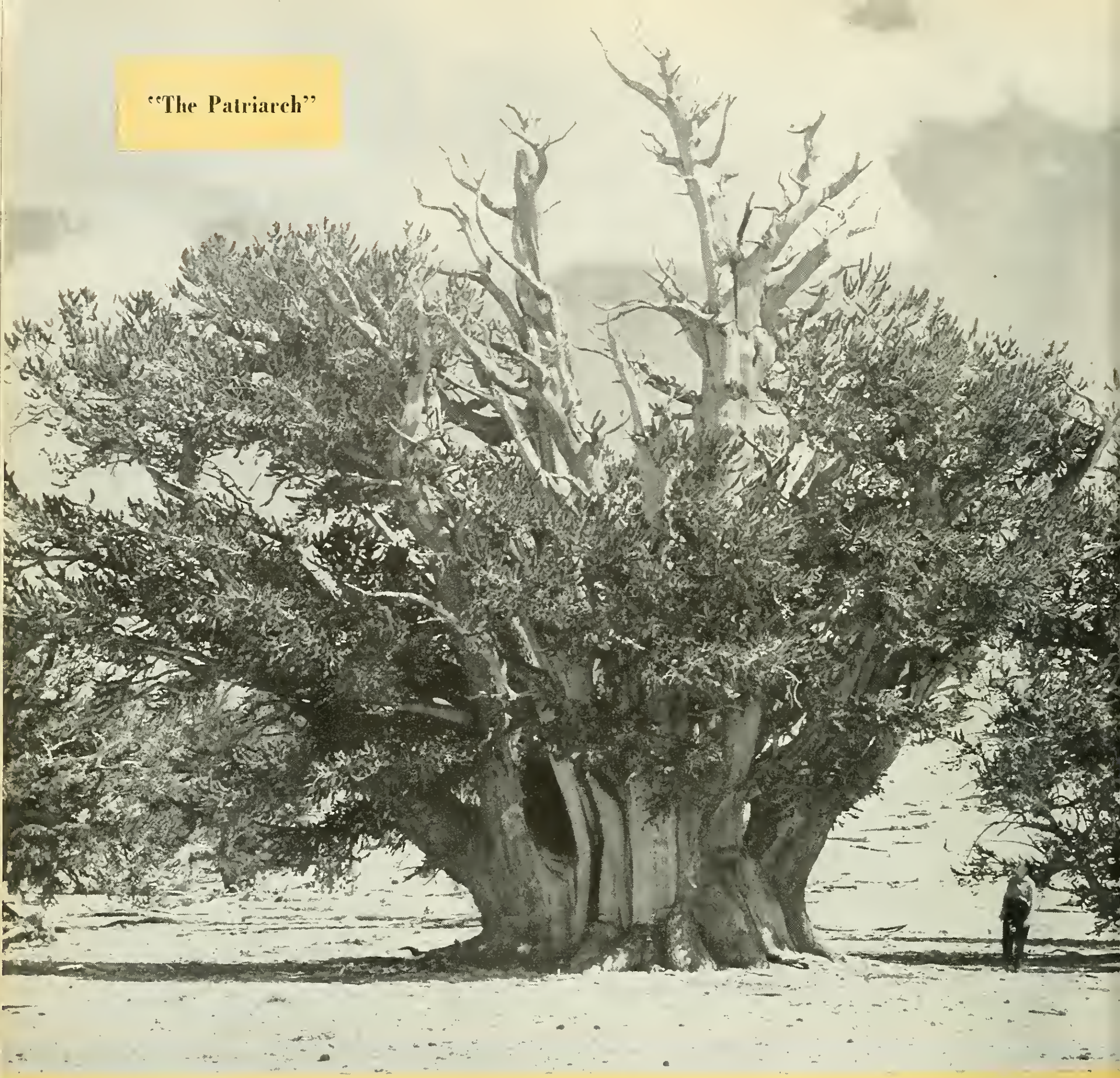
* A. R. Cahn, in *Pearl Culture in Japan* (Tokyo, 1949), indicates that epithelial tissue need not be wrapped around the nucleus, but must be placed adjacent to it.—ED.



⮝ THIS SHRUB-SHAPED TREE is thought to be the oldest pine yet known. The girl standing at lower right shows its size. Test borings by experts reveal 1500 years of growth.

Something New IN OLD TREES

By HAL ROTH
Photographs by the author

A newly discovered forest of bristlecone pines may harbor gnarled giants surpassing the Sequoias in age

HIGH in the White Mountains near the California-Nevada border, on a remote and inaccessible 11,000-foot plateau in Inyo National Forest, an unusual growth of rare bristlecone pines (*Pinus aristata*) has recently been designated a Natural Area by the U. S. Forest Service.

More than 900 annual rings were counted on a 27-inch wood sample cut from a dead tree. "It is barely possible that a few of the larger trees [in this area] might surpass the Sequoias in age," said W. S. Davis, Supervisor of Inyo National Forest.

A forest consisting almost entirely of bristlecone pines was unknown until the White Mountain Forest was recognized and explored by the Forest Service. Bristlecone pines usually occur as a thin fringe near the timber line in high mountain ranges. The trees previously found have been scattered through other groves, usually of limber and other soft pines. A small fringe tract of that type on the north slope of Mount Evans in the Colorado Rockies had been classified as the Mount Goliath Natural Area, but the White Mountain Natural Area protects an extensive forest of pure bristlecone pines. Half of the 2,330-acre Natural Area is covered with them. In certain places the trees are dead or dying, but the forest itself is not declining, for many vigorous seedlings and young trees are found in other parts.

The dead and dying trees have lain undisturbed for centuries, and the ancient trunks have been eroded by wind-driven ice particles, dust, sand, and rock fragments. These have cut away the softer wood and left the more resistant parts in relief. The bleached, upturned roots have become gnarled and twisted into forms a surrealist painter might well strive to duplicate.

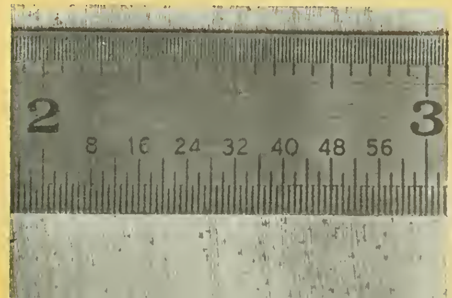
Recent tree-ring studies have focused attention on conifers on marginal sites in semi-arid regions of the western United States. These studies have shown maximum ages for pines far exceeding those generally accepted, according to Dr. Edmund Schulman of the University of Arizona. "The trees of great longevity that have been found recently," he says, "are all from environments strongly limited in moisture or temperature or both. . . . Many of these trees are sound and would appear to have life expectancies still measurable in centuries. . . . The limber and bristlecone pines have been only spottily sampled, and their maximum age distribution patterns are particularly ill defined. Since other long-lived species of pines remain to be studied, we can conclude that pines of certain types can at least slightly exceed 2,000 years in age."

Just outside the western boundary of the Natural Area is a bristlecone pine 36.7 feet in circumference, which the American Forestry Association has recognized as the largest of its species known. It was discovered by Ranger Alvin E. Noren and has been named "The Patriarch." Unfortunately, this champion tree wasn't included in the Natural Area, but there is a chance that even larger and older trees will be discovered within the Natural Area. On the basis of increment borings and other evidence, Dr. Schulman has assigned an age of 1500 years to The Patriarch.

The White Mountains are 20 to 40 miles east of the Sierra Nevada and roughly parallel to them. The mountains are rather dry, barren, and smoothly faced. Near their top is a large rolling plateau about 10,500 feet above sea level, on which one can drive about quite freely, though access to the plateau is over an extremely steep, primitive road.

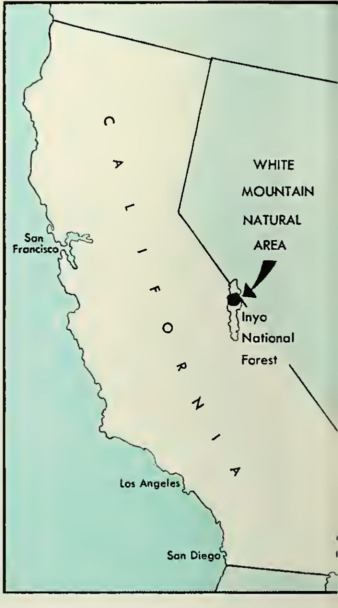
◄ THE TRUNK of "The Patriarch" measures 36.7 feet in circumference. Though it is made up of many stems fused together, the tree is considered an entity because all the stems originated from a single "root crown."

▼ A MAGNIFIED section of bristlecone pine wood shows 75 annual growth rings to the inch.



▲ A GENERAL VIEW of the bristlecone pine forest.

◀ DEAD AND DYING trees at the edge of the timberline have been etched into surrealist shapes by particles of ice, dust, sand, and rock.


C A L I F O R N I A
WHITE
MOUNTAIN
NATURAL
AREA
San Francisco
Inyo
National
Forest
Los Angeles
San Diego

The power of an automobile engine is greatly reduced, because of the altitude, and a four-wheel drive, low-geared jeep or truck is recommended, although a good driver can force a passenger car up the unimproved road.

Mule deer are common and Rocky Mountain sheep occasionally travel through the area. There are signs that it was once an ancient Indian hunting ground.

Owens Valley (4000 feet in altitude) separates the Sierra Nevada and the White Mountains. From a lookout in the White Mountains, the traveler has an exciting view of the great eastern face of the Sierra Nevada, soaring almost straight up for 10,000 feet. In one glance, the eye scans 80 miles of the highest mountains in the country.

The trunk of the bristlecone pine is usually 15 to 30 feet high and 12 to 18 inches in diameter (the monsters excepted). The wide bushy crown is made up of long, upright top limbs and short, drooping lower ones. The dull, reddish-brown bark occurs in small flakes. The foliage is dark green and clustered at the ends of the twigs. The needles come in groups of five and are about an inch and a quarter long.

The ripe cones mature at the end of the second season and are from 2½ to 3½ inches long, colored a deep chocolate brown, with a touch of purple. The end of each cone scale is tipped with a fragile thornlike prickle.

The wood is brownish-red and light in weight. It is coarse-grained, soft, very brittle, and of little use except locally for fencing.

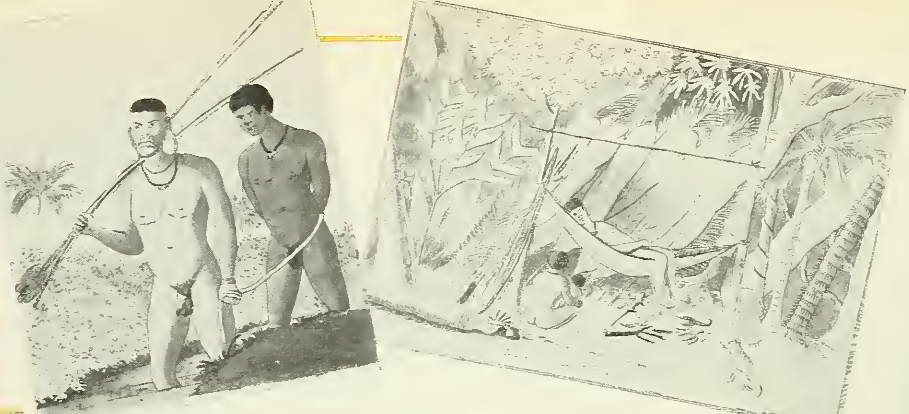
A welcome hybrid

Dr. Herbert L. Mason of the University of California welcomes what appears to be a natural hybrid between the bristlecone pine and *P. Balfouriana.* "This," he says, "indicates the possibility of further studies on the crossing of these two species to determine their genetic relationship and to attempt through crossing . . . a program of improvement of form adapted to desert ranges."

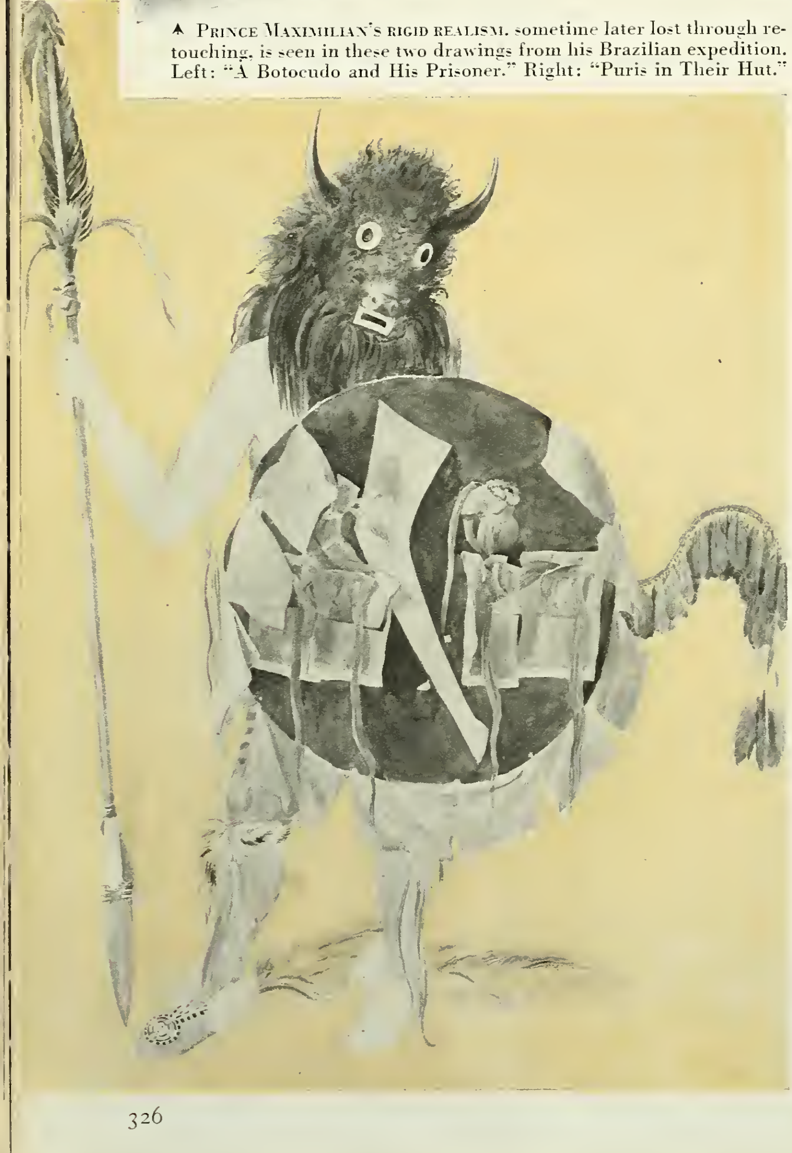
In a preliminary report, N. T. Mirov, plant physiologist of the California Range and Experiment Station, expressed the opinion that the bristlecone is an ancient, remnant pine. He bases this on the fact that its distribution is scattered and restricted chiefly to high elevations, where it occurs in patches. He suggests that some time near the beginning of the Quarternary period of glaciation, the forests that grew in the Great Basin began to suffer from lack of rain. This apparently caused most of the pines to die. Some, however, adjusted to the dry environment and became piñons; others survived in the cooler environment of the higher mountains and became bristlecone and *P. Balfouriana.*

The access road to the Natural Area may be improved in connection with a Navy High Altitude Research Station farther north. In view of this, it is fortunate that the Natural Area has been established, for it will help to prevent souvenir hunters from taking the ancient wood for woodworking purposes. Under further scientific study, these noble old pines may shed new light on certain aspects of botany and on the climatic history of the continent.

▼ WHITE MOUNTAIN NATURAL AREA offers a spectacular view of the Sierra Nevada.



▲ Prince Maximilian's rigid realism, sometime later lost through retouching, is seen in these two drawings from his Brazilian expedition. Left: "A Botocudo and His Prisoner." Right: "Puris in Their Hut."



◀ Bodmer's Mandan Buffalo Dancer: an early drawing from the upper Missouri, recently circulated in a traveling exhibit.

Th and th

By coincidence, the year 1832 saw two important events that were strikingly similar. In that year, before the era of photography and while our Indians were still following their ancient ways, two skillful and diligent students of primitive life, George Catlin and Prince Maximilian zu Wied Neuwied, quite independently journeyed into our western wilderness to study the native tribes and to depict their life. Both of these men also studied the natives in Brazil; and both left valuable collections of paintings.

But, whereas the adventures of Catlin are well known, both to students of the Indian and to the general public[1], the work of Prince Maximilian has only recently begun to attract notice in America. Catlin reached the public through five books, and his paintings and drawings have been preserved in the U. S. National Museum and the American Museum of Natural History. But Prince Max, as he was affectionately called by his contemporaries, has not even achieved mention in some of the most compendious encyclopedias, though he was

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[1] See "Frontier Painter," by Bates M. Stovall, in Natural History for November, 1954.—Ed.

A fresh view of vanished peoples can be gained through the writings and paintings of Prince Maximilian and his artist Carl Bodmer, whose early exploration in the Western Hemisphere have remained almost unknown

*The author of this article is Director of the Mittelrheinisches Museum at Coblenz, Germany. He found the pictures described here in the castle of Neuwied on the Rhein, where they had lain for 100 years, and undertook a study of them. He was active in preparing the exhibit for circulation in this country under the auspices of the Smithsonian Institution and is now working to bring the Maximilian-Bodmer material out in well-annotated form—Ed.

rince
ainter

By Joseph Röder*

one of the great scientific explorers of his time.

To complete the coincidence, his valuable bird collections have come to rest in the American Museum of Natural History under the same roof as over 400 of Catlin's paintings.

At the age of 33, Prince Maximilian had fought against Napoleon and retired from the Prussian Army with the rank of Major. He then undertook his important expedition to South America, arriving in Brazil in 1815. This was even before the journey of Alcide Dessaline d'Orbigny, whose appointment as traveling naturalist for the Museum of Natural History at Paris took him there in 1826[2].

Prince Maximilian's diaries of his memorable three-year journey between Rio de Janeiro and Bahia are decorated by numerous drawings, which provide the oldest source of information on the life of some of the primitive tribes of the virgin forests. He visited the Puri, the Botocudos, the Patacho, and the Camacan. In addition to his Indian subjects, he depicted the lower class Brazilian and Afro-Brazilian popu-

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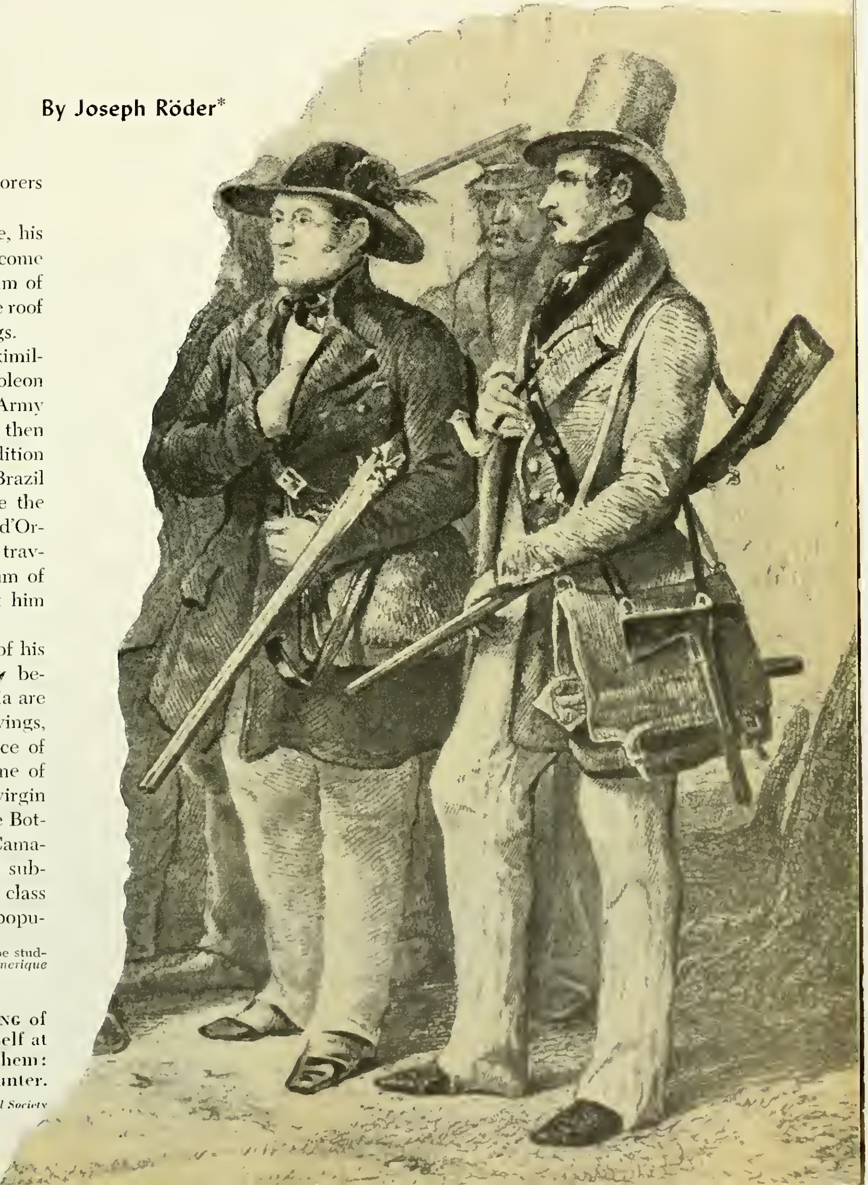
[2] The results of d'Orbigny's journey can be studied in his great work, *Voyage dans l'Amerique Meridionale (1839-1842).*



➤ Part of Bodmer's drawing of Prince Max (left) and himself at Ft. Clark, N. D. Behind them: Dreidoppel, servant and hunter.

Courtesy New York Historical Society

lation between Rio and Bahia, showing their habits, clothing, houses, tools, and occupations.

The published works covering this journey[3] scarcely do justice to the original material. The original pictures possess high scientific value, but they have suffered in the rendition[4]. Some were retouched by his brother Charles and his sister Luise, not to mention the engravers. While this may be said to have rendered the plates and vignettes of the *Reise nach Brasilien* very beautiful, the alteration has hurt them very much. His originals are particularly valuable because they retain his inflexible determination to portray things accurately. His drawings might be called awkward, but they are beautiful in the primitive sense.

It is perhaps fortunate that Prince Maximilian had no formal artistic training, for he might then have twisted his hand and eye to mold his aboriginal Americans into the classical form. Other painters of his day gave the bodies of Greek gods to the red man and idealized the scenes to fit Rousseau's then popular concept of the Noble Savage. Prince Maximilian held himself firmly, if sometimes clumsily, to reality. It is the more important that he did so, because his travels both in South America and the United States took him among tribes that were destined soon to be overwhelmed by modern civilization. The scenes he recorded can never be recaptured.

When Prince Max came to the United States in 1832, a feeling of his own artistic insufficiency apparently caused him to bring the Swiss draftsman Carl Bodmer with him. Bodmer made scores of watercolors and drawings on the expedition, but it has only recently become possible for Americans to see any of the originals. The drawings lay idle in a German castle on the Rhine for more than 100 years. Last October, 121 out of his 200 paintings were brought to New York City by Prince Maximilian's great grand-nephew, Prince Karl Viktor zu Wied of Munich. The paintings were insured for $150,000 and have been on tour under the auspices of the Smithsonian Institution and the German Government. The citizens of a dozen or more cities have been given opportunity to see them.

The fictitious baron

Prince Max, who traveled in the United States as Baron Braunsberg, made his headquarters the first winter at New Harmony, Indiana, a prominent cultural and scientific center. Here the social experiment known as the Harmony Society had been established around 1815, but by the time Prince Max arrived, dissension had ended the Communist colony as a distinct enterprise. In company with the American naturalist Thomas Say and William Maclure, he made a careful study of local natural history. In the spring, he and his helpers departed by way of the Wabash, Ohio, and Mississippi rivers to the Missouri, which they followed upstream as far as the Rocky Mountains. The presence of Carl Bodmer naturally deterred Prince Max from illustrating his diary with his previously abundant sketches. But his text contains many

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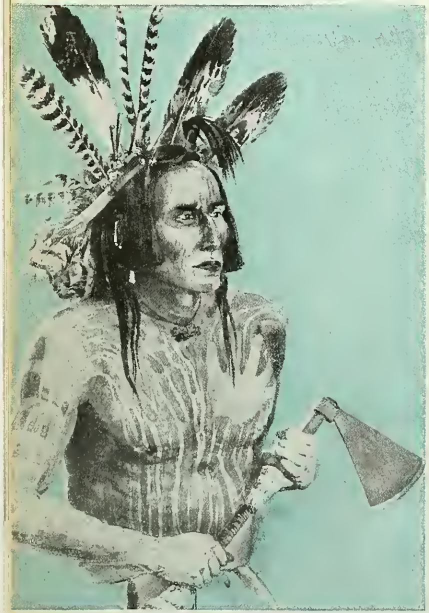
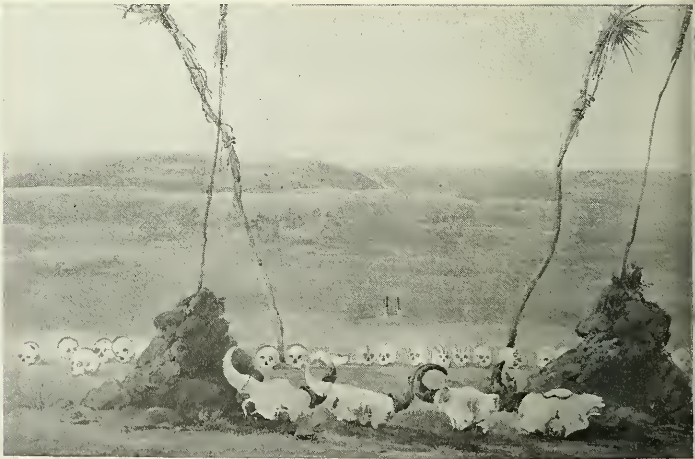
[3] *Reise nach Brasilien in den Jahren 1815 bis 1817*, 2 Bde. (Frankfurt am Main 1820-1821); *Abbildungen zur Naturgeschichte Brasiliens*, 15 Lfagn. (Weimar 1822-1831); *Beiträge zur Naturgeschichte von Brazilien*, 4 Bde. (Weimar 1825-1832).

[4] The author has recently published in collaboration with H. Trimborn *Prince Maximilian of Wied. Unpublished Drawings and Writings on Brazilian Folklore* (in German); also, by himself, *Prince Maximilian of Wied. Journey to Brazil, 1815-1817* (in Portuguese).

Photo by W. Rüsch



▲ THE MANDAN CHIEF, MATO-TOPE, who was friendly to the whites until ravaged by smallpox.



▲ SACRIFICIAL PLACE of the Mandan Indians, painted in water color by Bodmer in November, 1833.

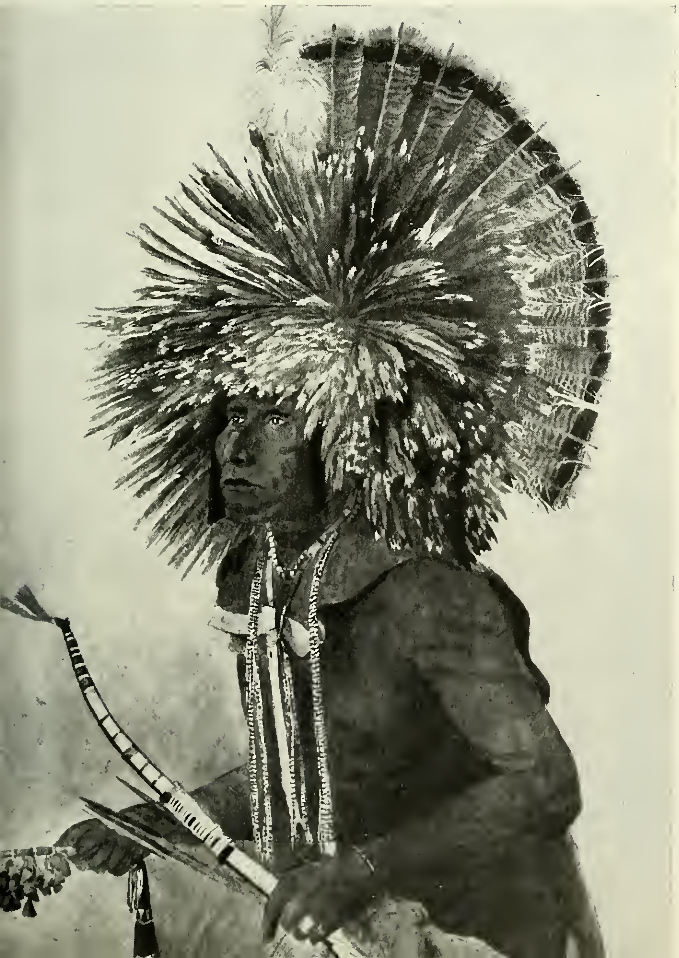
➤ ORIGINAL OF PEHRISKA-RUHPA
Dog Dancer. Bodmer knew lithogr
and refined his drawings in the pr

observations on the folklore of the Indians and is a most valuable contribution.

Bodmer, then only in his twenties, carried out work that will keep his name alive after all the other labors of his long life are forgotten. He painted the Indians probably better than any other artist of his time, depicting them in all their strangeness, courage, pride, and vanity. He painted them with their buffalo cloaks and their feather finery—Ponco, Oto, Omaha, Mandan, Hidatsa, Assiniboin, Cree, Piegan, Blackfoot, and Blood.

As John C. Ewers, Associate Curator of Ethnology at the United States National Museum, expressed it: "Bodmer's Indians are never hasty impressions or vague generalizations of some idealized Indian type. They are bold, clear likenesses of individuals. The exact forms of their garments, the precise patterns and colors of decorations in paints, dyed porcupine quills, and glass trade beads, the shapes and colors of elaborate hair and neck ornaments and the details of weapons and other accessories are delineated meticulously. These pictures possess a remarkable sharpness and depth of focus.

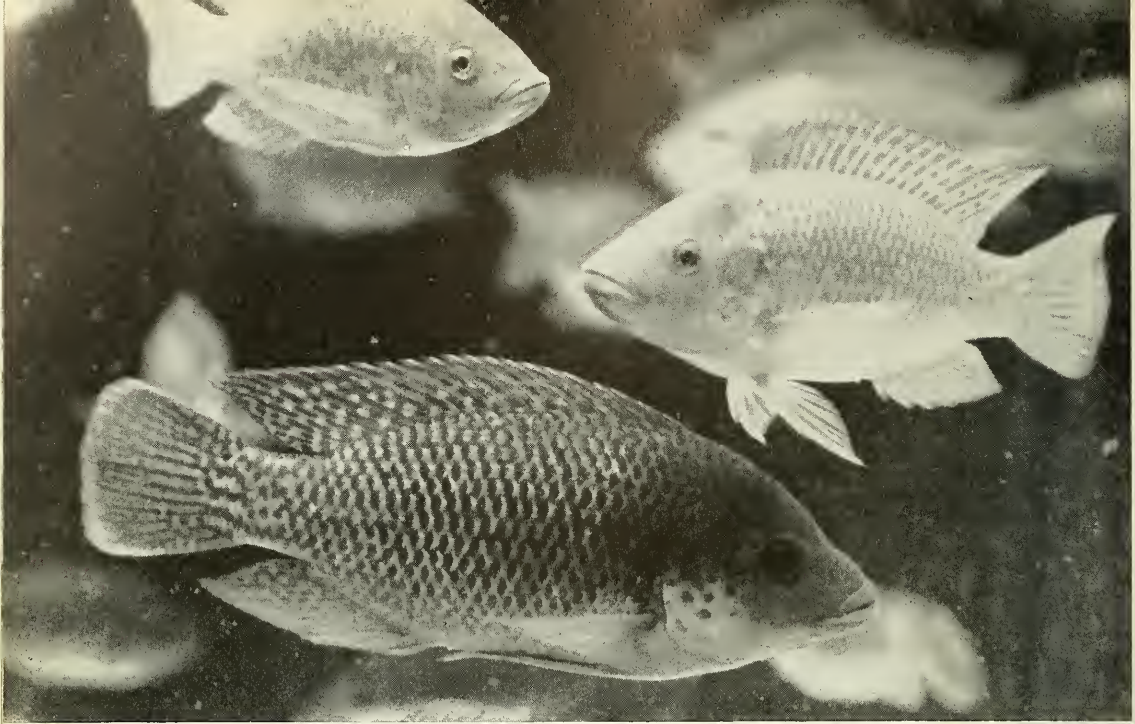
"The same qualities of accurate observation and precise execution may be seen in Bodmer's scenes of Indian villages and trading posts, of Indian burials and sacrificial places. In his landscapes he recorded the varied character of the Indian country, its broad rivers and plains, its bluffs and its mountains, as faithfully as he portrayed the likeness of the Indians."



Looking back upon the magnificent personalities he depicts and knowing that these people were doomed to ruin, we find his paintings extraordinarily beautiful and matchlessly great. There is Mato-tope, the Mandan, who had been a friend of the white man all his life but in his last hours, ravaged by smallpox, gave a stirring oration urging his people to fight the intruders. And there is Perhiska-Ruhpa, the Hidatsa, in the dress of a "dog-dancer," one of the most beautiful ethnographic portraits ever painted. These and many other men and women rise before us in Bodmer's paintings. His casual sketches are almost as impressive.

The English version of Prince Maximilian's North American journey was published in 1843, but the translation, being a free one, is not scientifically valuable. The original German edition, which was published under the title *Reise in das Innere Nordamerika* (1839), contains 48 large copperplate prints, which in the most expensive editions are colored by hand, and 33 vignettes. The work was issued under the artistic direction of Bodmer, and its production in Paris required years. Its illustrations belong to the best pictures in the literature of early travels.

However, a great part of the most valuable material has not yet been published. Prince Max's original sketches have a quality all their own. Also, he stands out as one of the classic writers describing the Americas, and it is sad that the archives of this great scholar have not yet been examined in detail. Readers will find many references to Prince Maximilian and Bodmer in Bernard De Voto's recent book, *Across the Wide Missouri*, as well as a number of Bodmer's drawings. But a new and better edition of Prince Maximilian's original material is planned. The editing will be much more exacting than could have been possible in Prince Maximilian's time. But the task may consume several years, for the co-operation of various institutions and specialists will be needed in annotating a work dealing with so many sciences.



U. S. Fish and Wildlife photo by Stroup, courtesy Honolulu Aquarium

▲ TILAPIA MOSSAMBICA, from six to ten inches long.

Its Mouth is its Nursery

And its adaptability is making the Largemouth Kurper a promising source of revenue in Hawaii

By EDITH ELLIOT

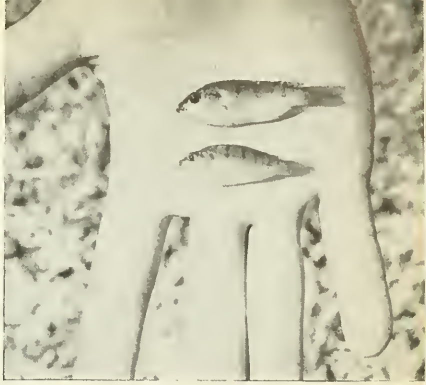
WHEN it comes to adaptability, a little fish known in certain parts of Africa as the Largemouth Kurper would appear to be almost as versatile and prolific as Li'l Abner's famous Schmoo. Scientifically it is known as *Tilapia mossambica*. Unlike most fishes, the largemouth kurper is not very particular about its environment. While it seems to be happiest in the brackish water found in the mouths of rivers, it can live and reproduce in pure fresh water, in salty water, or in muddy water. Give it a temperature of 75 to 85 degrees, and little else matters. It is not particular about its food; and it has a high resistance to many diseases with which fishes are afflicted.

Furthermore, the kurpers are not too particular about the size of their environment. They can be kept in tropical fish aquaria, yet they have also been found in the sea. Although in confinement they remain small, they can attain a weight of as much as six pounds in open water.

Studies by zoogeographers show that the family to which this fish belongs, the Cichlidae, is a very large one. Aside from Africa and Asia Minor, its members are found in lakes, ponds, and streams from Texas to South America, in the islands of Cuba, Haiti, and the Dominican Republic, and in India, Ceylon, and Indonesia.

In the last two years largemouth kurpers have been introduced to the waters of Hawaii for study and for commercial purposes. Vernon E. Brock, Director of the Territory of Hawaii Division of Fish and Game, headed studies to evaluate the largemouth kurper as a substitute bait for tuna. Commercial tuna fishing is an important industry in Hawaii, and the local bait, *nehu*, was fast disappearing. In addition to this use, the Hawaiian tuna packers convinced themselves that the largemouth kurper would be acceptably palatable when canned. As the result, there is a growing demand for the fish for stocking breeding ponds.

Breeding experiments in Hawaii, using natural brackish tidewater pools, have shown that spawning



▲ **Newcomers:** Young *Tilapia* bred in Hawaii's brackish ponds.

▲ **Bait shortage overcome:** fishing from the "Buccaneer," a commercial boat in Hawaiian waters, using *Tilapia* to attract the larger fish.

▲ **Edible** but valued as bait: an adult, also taken in Hawaii last year.

takes place when the fish is three and one-half months old. It is repeated every month and a half during the fish's life. At this rate, a pair of kurpers could theoretically become the progenitors of a million and a half fish in a year! A lake with a surface area of one acre could yield as much as 5000 pounds of these fish annually.

The largemouth kurper is a mouthbreeder and as such takes special care of its eggs and young. Shortly before egg-laying takes place, the male fish prepares a "nest," which consists of a shallow pit in the sand, cleared of all debris. Here the female lays her eggs, but she immediately thereafter takes them into her mouth. One can imagine the domestic havoc that would result if father kurper should fail to do a good cleaning job and leave bits of hard shell and seaweed lying around. Mother kurper carries the eggs in her mouth for ten to twelve days before they hatch. During this time, she does not eat but constantly mulls the eggs about in her mouth.

After hatching, the young continue to have rooming-in privileges. They are carried about in the mother's mouth until they are fully capable of caring for themselves in the outside world. They get the same mulling over that the eggs received during their first few days. This motion apparently strengthens the little kurpers; by the time they are allowed out, they can swim quite well. They then hover about both parents in a dense cloud, and the parents often face in opposite directions to watch for trouble. When danger threatens, a warning is signaled by movement of the mother's fins or body. At this signal, the young fish instantly turn and swim into her open mouth. Such protection assures a relatively high percentage of survival.

Except in the breeding season, the largemouth kurper is mild-mannered, and its color is dark with a glinting, metallic green tone marked with irregular dark spots and stripes. During the breeding season, when excited, the body turns very dark, and four light spots are highlighted along its side. The male's jaw becomes nearly white.

Wholesale reproduction and survival, great adaptability, and dual utility as bait fish and food fish have created mounting interest among commercial fishermen in the versatile largemouth kurper. As a novelty in the home aquarium, the fish may be in short supply, because wholesale and retail dealers have not generally stocked it. However, it can be purchased on special order from collectors who handle rare fish.

continued from page 307

times resembles an artillery barrage, is due to the fact that sound travels comparatively slowly. Waves from a distant portion of a single lightning stroke may be appreciably longer in reaching the listener's ear than are waves from near-by segments of the flash.

Most estimates of lightning's electrical power are in general terms. Steinmetz calculated that an ordinary flash involves 500 million kilowatts. That is more than 30 per cent of the capacity of all U. S. power plants. Yet the commercial value of the total energy in a bolt is probably less than 1 10 of a cent. Why? A flash that has a duration of 10 millionths of a second is unusually long for nature's generator.

Speed and high potential are keys to lightning's destructiveness —and pranks. Though it would light a 75-watt bulb for only a few minutes, a charge that acts with proverbial lightning-speed can destroy a cathedral. It actually moves so fast that copper wires are sometimes vaporized without burning surrounding rubber insulation.

Steam produced by lightning's heat is responsible for the explosion of trees. Under impact of the current, sap is turned into gas so rapidly that it acts with the force of dynamite. Yet in freak accidents, jewelry has been melted from the bodies of women without killing them.

This strangely puckish demon plays many odd tricks. Lightning once struck a furniture factory in Grand Rapids, Michigan, and set the place on fire. Then a companion bolt struck a few seconds later. It hit a fire-alarm box, set it off, and brought four companies to the scene.

For some reason other than sheer perversity, lightning strikes oaks and firs fifteen times as often as varieties of beech. And it prefers elm or chestnut to maple or birch —probably because of differences in electric conductivity of the various species.

No tale about lightning is actually beyond possibility. There is an authentic case in which lightning struck a tree with such violence that it caused a near-by well to go dry.

Though the average building stands a statistical chance of taking one stroke every 40 years, actual distribution is not that uniform. Even in areas where danger is greatest, lightning-launched fires can be practically eliminated by installation of suitable protective equipment.

Cities are safer

Urban homes are comparatively sheltered. Tall buildings, power lines, and smokestacks tend to draw the majority of flashes in the area. Structures such as the Washington Monument and Pittsburgh's Cathedral of Learning are struck many times each year. City dwellings are also partly protected by their plumbing and heating systems, which help to carry off any charge that may hit. Your TV antenna is a likely target but is harmless if properly grounded.

Even in sparsely settled areas, lightning rods give high protection if properly installed and maintained. A 20-year study of Iowa farm buildings gave conclusive figures. Approximately half the structures were unprotected, the other half rodded. Lightning damage to protected buildings was $380,841. Those without rods suffered losses of $2,539,000 in the same period. So if you live in a hazardous area, don't take chances with your home and other buildings.

But don't try to put up your own rods unless you can follow specifications furnished by the U. S. Bureau of Standards or your insurance company. It isn't enough to rig gear on the roof at random. Points and wiring must be of proper gauge, located at strategic sites. And the whole system is useless unless satisfactorily grounded. Let a professional do the job for you—or take great pains to meet standards set up by experts in the field. Improperly installed or poorly maintained rods may be worse than none. Such a system may attract a charge without being able to carry it into the ground.

Whether a house is rodded or not, the likelihood of fire is much greater than direct personal injury. General Electric expert K. B. McEachron once suggested that there are only two absolutely safe places in the average home. If you want 100 per cent protection, he said, crawl into your refrigerator or furnace. If you find this inconvenient, take sensible precautions such as avoiding chimneys and electric equipment during a storm. Your chance of being hit is almost nil.

Even outdoors, where danger is greatest, you can be reasonably safe by observing basic cautions. Remember that lightning seeks the tallest object in a charged field. In open country, you may be that target if you stand erect when lightning is striking. If a group is caught in such fashion, it should scatter as widely as possible. In the case of cattle as well as men, groups are more likely to be hit than isolated individuals. One blast that struck Wasatch National Forest, Utah, killed 504 sheep but bypassed laggards that had wandered from the flock.

Especially during the heavy lightning season, avoid making camp on open rocky ground. Your body is likely to be the best conductor in the area. No matter what the terrain, don't fall for the old superstition that lightning never strikes twice in the same place. It has hit the Empire State Building as often as 12 times in 20 minutes.

If you see a flash and hear its thunder practically at the same instant, it was very close to you. Another clue to a near-miss is the smell of ozone. Caught in a charged field with bolts striking near you, throw away gun or fishing gear and sprawl flat on the ground. Don't try to run for shelter until electrical disturbances have subsided entirely.

Poor shelter is always worse than

none. That big tree will keep most of the rain off you but may draw a bolt of lightning. Should it be struck, current will pour down its trunk into the ground. Much soil is of low conductivity. So when lightning is surging away from a tree it may go up one leg and down the other of any person standing near-by. Many cattle are killed in this way, and studies by the Metropolitan Life Insurance Company indicate that at least one-third of all the persons who have been killed by lightning have sought shelter under trees.

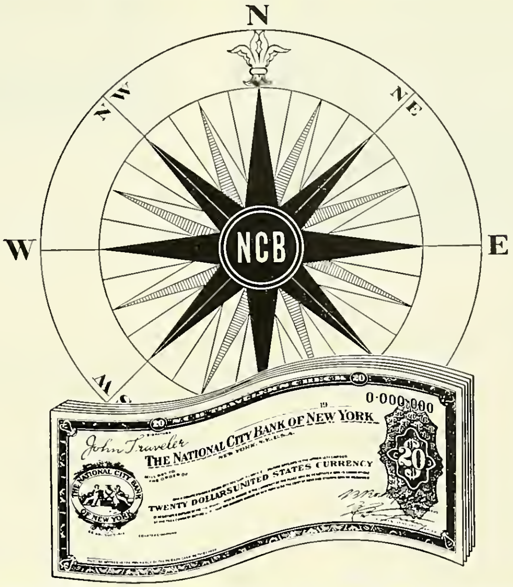
Avoid hilltops, wide open spaces, isolated sheds. Keep a strong respect for metal fences. Unless grounded every 150 feet—and few of them are—a fence can transmit lethal charges a considerable distance. Don't touch one even after the storm is over; it may have built up and maintained a charge still sufficient to kill.

If a thunderstorm boils up when you are swimming or out in a boat, head for shore at once. A small wooden craft, especially if equipped with a mast, may be very dangerous. And a metal fishing rod acts like a miniature lightning rod; it discharges its current into the person holding it rather than into the ground.

Experts are unanimous in advising that the safest spot outside a shielded building is a car or bus with metal top. But don't try to run for it if it means dashing across a stretch of open ground. Take shelter in a cave, gorge, or dense woods. Or just lie down in the mud and think about how nice it will be to continue paying insurance premiums for years and years.

In spite of all these cautions, you don't need to become a victim of keraunophobia — "morbid fear of lightning." For even if you should be caught on the short end of the 300,000-to-one odds against being struck, it isn't necessarily fatal. A Frenchman named Beltram was struck five times by celestial bolts —and in his old age died of pneumonia.

NATIONAL CITY BANK TRAVELERS CHECKS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GERMANY —*Frankfurt Representative Office*

**Military Facility*

Good natural history photography distinguishes the Swedish film "The Great Adventure."

The Screen

Authoritative comments on films in the field of nature, geography and exploration

Edited by Elizabeth Downes

The Great Adventure

Reviewed by Harold E. Anthony

Deputy Director
Chairman and Curator of Mammalogy
American Museum of Natural History

THIS motion picture, in color, is the dramatized account of a young boy's experiences with wild animals in a Swedish farming community. The story is told by a commentator who explains the events as things that happened to him in his childhood. While the narrative is fictional, the action is exceptional wildlife photography; and, in most respects, the over-all impression is plausible and pleasing.

The hero of the story and his smaller brother live on a farm adjacent to lake, marsh, and uncultivated terrain, the home of interesting mammals and birds. The age-old warfare between predator and barnyard dwellers provides a sequence where the farmer eliminates almost an entire fox family, one survivor escaping.

The greater part of the action revolves about a young otter, which first appears as a competitor with man's fishing interests, and hence to be caught and destroyed. The young brothers save the otter, hide it in their attic, and have a long series of interesting and entertaining experiences with it during the winter. One wonders how so much activity could have been kept secret from the grown-ups for such a long time, but eventually the news breaks. With the advent of spring, cranes call from the skies, the black cock parades on the mating grounds, and chill winter relaxes over the land. This proves too much for the tame otter. He seeks his own kind, and the boy is disconsolate.

There is a great deal of good natural history photography, much of it obviously uninhibited. Some of the animal behavior implies a familiarity with man; if the animal was not semi-domesticated, it had at least become so conditioned to man's presence as to have lost its pristine shyness. Nevertheless one gets a fair impression of how wild animals behave about a Swedish farm.

A Louis de Rochemont Presentation

Land of Fury

Reviewed by Harry Tschopik, Jr.

Assistant Curator of Ethnology

THIS is the first feature-length movie ever to be filmed in New Zealand, and considering the trouble and expense that the J. Arthur Rank organization went to in order to make it accurate and authentic, the results couldn't be more disappointing. The story deals with the settling of New Zealand by the British in the 1820's, and the relations between them and the warlike Maoris.

The plot, when it can be perceived at all, is inept and confused, and the fact that the Maori extras speak their native language for almost half the picture doesn't make it more lucid.

On the credit side are the breathtaking views of jungle-covered mountains, fern forests, geysers, and mud pots. The sets are lavish, and the re-creation of native life is, on the whole, accomplished with considerable skill. Entire villages filled with elaborately carved statues and house posts were constructed with great attention to detail. Best of all are the real Maoris, dressed in authentic costumes and ornaments, their faces painted to simulate the extensive tattooing then in vogue. Some of the dances, however, are suspiciously theatrical, and much of the music has been orchestrated for the western ear.

For sheer mayhem and massacre, the climax matches anything ever brought to the screen. There are so few people left, in fact, that the producers felt it necessary to bring over another boatload of settlers in the last scene.

A J. Arthur Rank Presentation

Green Magic

Reviewed by Harry Tschopik, Jr.

Assistant Curator of Ethnology

IT is difficult to make a fair and just appraisal of *Green Magic*, the prize-winning South American safari film produced by Leonardo Bonzi for Astra Cinematografica of Rome. Owing to the excellence of the photography, to some highly dramatic sequences, and to many scenes of great pictorial beauty, it is impossible to condemn it in unqualified terms. On the other hand, because of many inaccuracies and misrepresentations, it is equally impossible to give it a clean bill of health as a documentary.

This feature length film depicts the experiences of the Bonzi Expedition during a 7,800-mile trip of six months duration across South America from Rio de Janeiro, Brazil, to Lima, Peru. Traveling in two jeeps, the four Italian movie makers claim to be the first to traverse this often-trackless route by automobile, and their pictorial record of pampas, jungle, swamps, rivers, waterfalls, and finally the Andes, is often breath-taking.

Along the way their cameras record a variety of people and activities—the fishermen of Bahía, the diamond hunters of Mato Grosso, and the orgiastic rites of the Afro-Brazilian negroes. Homesteaders fell the virgin forest, and Gauchos drive their cattle across piranha-infested rivers. Other sequences deal with the rubber gatherers of the deep jungle and the Aymara Indians of the Andean plateau.

Yet the story line is weak and contrived, and in the interest of dramatic effect, the editing is deliberately misleading. Thus the frenzied sacrificial dance sequence, which was apparently filmed near Bahía on the coast, is made to appear as though it occurred in Mato Grosso, several thousand miles away in the interior. The Aymara wedding dance incident is almost entirely fictitious, and the principal performers are not even Indians. Some of the "wild" macaws have their wings clipped, and the animal identified by the commentator as a "jaguar" is an ocelot. *Green Magic* is good entertainment, but it is a poor documentary. *I.F.E. Releasing Corp.*

CARBON + HEAT + PRESSURE = DIAMOND!

continued from page 293

We must remember the certainty, not just the remote possibility, that one day we shall run out of natural diamonds.

Industrial diamonds actually include a wide range of materials, whose selling price may be as low as $2 or $3 a carat, or as high as $40 or $50, depending upon the use to which they are put. The poorest and cheapest stones are so flawed and fractured that their only value is for abrasive powder, after they have been crushed and sized. Diamond cutters use quantities of such "dust" to polish their gemstones, since nothing else will abrade a diamond. Even though the dust is expensive, it finds its way into many other places where it is used for cutting substances much softer than a diamond. Its hardness saves so much machine time that the greater tool cost is offset by other savings.

More expensive and solid industrial diamonds are used to shape and dress some of the tools used to work metal. Tungsten carbide is so hard that it can be used to cut steel, but the carbide itself must be shaped, and diamonds are used for that. Oil wells are drilled with pipe-shaped bits whose edges are studded with small crystals of diamonds. When sinking a hole to a depth of 5000 feet or more, it is far more important to have at the bottom a tool that will cut hour after hour than a cheaper one that frequently will have to be replaced.

The most expensive industrial diamonds are the off-color but gemmy crystals that are sound enough to have small holes drilled through them. These are used as dies for the drawing of wire. A diamond wire die will outlast many dies made of softer material. If we express the length of wire that can be drawn through an ordinary die in units of hundreds of yards, we would measure the diamond's yield in miles. When you consider the work involved in drilling an exact hole through a tiny crystal to make it into a die, the importance of this yield can be appreciated.

The industrial diamonds that GE produced recently are suitable only for the manufacture of diamond dust. As the company has said, the cost is many times that of the natural material. Very little information as to the exact procedure has been divulged. A giant press capable of 1000 tons pressure was used. It was apparently applied to a cylinder whose end was not much more than a square inch in area, for it was said that a pressure of 750 tons to the square inch was involved. Some device, termed the "belt," but not otherwise described, was credited with allowing the pressure to be maintained *with the heat* for as long as 16 hours. The material squeezed, of course, was carbon in some form. Perhaps it was embedded in softer iron, since the experimenters say they received some assistance from examining diamonds in meteorites.

From all this work, the largest single crystal is a tiny diamond one-sixteenth of an inch long, almost paper thin, weighing less than a hundredth of a carat. As GE's president has said, it is the most expensive diamond in the world!

The day will never come when laboratory diamonds will be so easy to make that they will glut the gemstone market. Even if it may someday prove possible to make inexpensive, cuttable crystals, the processing costs will remain high. Much of the final selling price lies in the cost of transforming unattractive pebbles into gleaming gems. The unparalleled hardness of diamonds makes this a tedious, expensive process. Amateur lapidaries, to whom rubies and sapphires are a breeze, seldom try to cut diamonds.

No, the real significance of the announcement is that finally, and unequivocally, *diamonds have been made, and can be made, over and over again, with consistent results, for the very first time.*

The crystals are very small. *En masse* they have a gray-brown color, a grain size approaching pepper, and here and there, as they tumble about, a sparkling face. The

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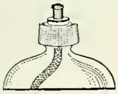

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largest crystal is just a thin sliver and appears almost colorless. As a natural diamond, its value would be negligible, a penny or two at most. (If it weighed a hundredth of a carat, it would be worth just three cents.) The crystals are so small that no attempt has been made to cut one to see how it behaves on the wheel. This is the test every diamond man would like to make. It is conceivable that the fast-growing crystals were under somewhat uneven stress, and that their atomic lattices are so distorted that they cannot be cut. About this we shall have to learn later.

Crystals of gem size, gem clarity, and gem color seem to lie far in the future. Whether they would be worth the expense and research that is still clearly necessary remains unanswered. The clue would lie in how easily the laboratory diamond could be detected. If it could be spotted by someone who is nearly an amateur, with no more instruments and training than the average jeweler, then the future of diamonds as gemstones is secure. (Rubies and sapphires offer a parallel; man-made stones are relatively easy to detect—because they are so perfect—and their price, oddly enough, is a small fraction of the price of natural stones.) However, if natural and laboratory diamonds should be indistinguishable, and this possibility cannot be excluded, then the value of natural stones would be affected. That day still seems more than a little remote.

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How diligently the synthesis of diamonds will be prosecuted is another uncertainty. It is improbable that the government will need to subsidize the erection of a battery of giant presses to turn out laboratory diamonds in time of war, as has been suggested by fanciful writers. After all, the United States has a magnificent stockpile of diamonds on which it can draw in time of crisis. For years the American public has been the greatest diamond customer, and the U. S. today probably owns as big a percentage of the world's diamonds as it does of its gold. Unlike the gold, however, it has cost the taxpayer nothing. The stockpile is not buried in Kentucky, but is distributed on the fingers of millions of American women. During the last war, Japan called in her privately owned diamonds. In a real emergency, Washington could do the same and would be smothered under a flood of diamonds that would see the U. S. through. Contrary to economics and popular opinion, the really valuable diamonds are the industrial ones. Fortunately, in a pinch, gem diamonds would serve nicely as substitutes!

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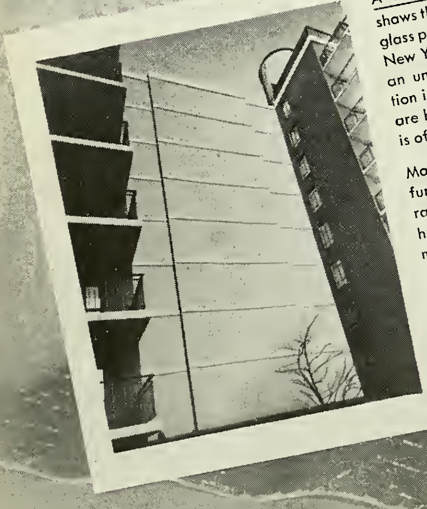

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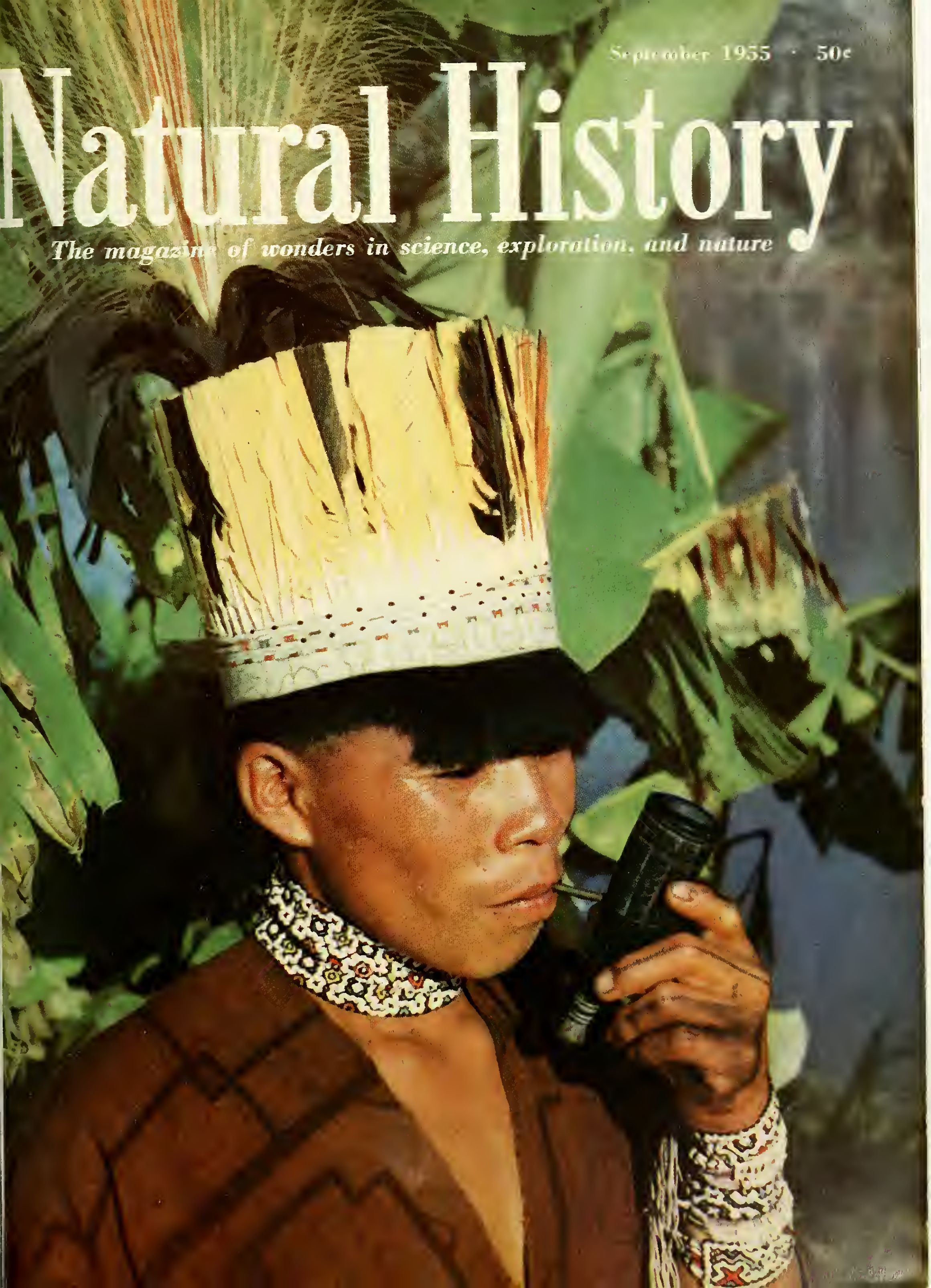

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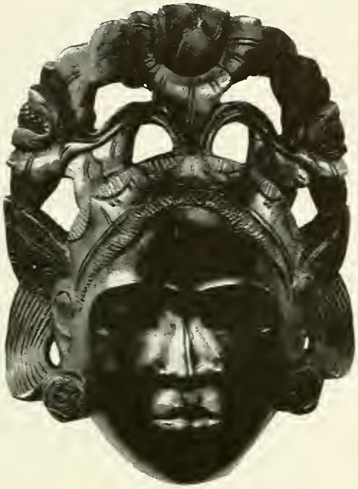

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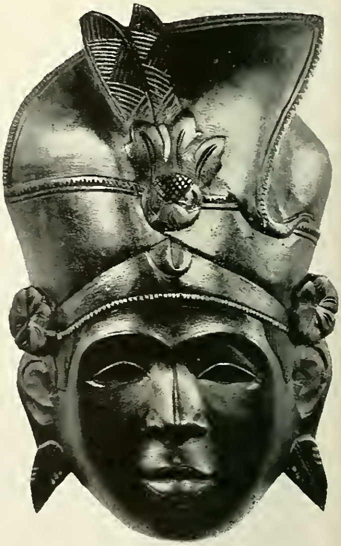

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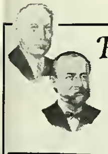

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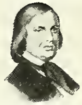

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September, 1955 Volume LXV, No. 7

Conibo Indian..Cover Photograph
From a color transparency by Harry Tschopik, Jr.

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Because of the insidiously poisonous waste products, widespread use of atomic power will call for continuous sideline vigilance from scientists and naturalists

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Dramas as tense as any in jungle or ocean depths are enacted under our very eyes

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The trouble to which primitive people go to get salt reminds us how fortunate we are to have a saltcellar on every table

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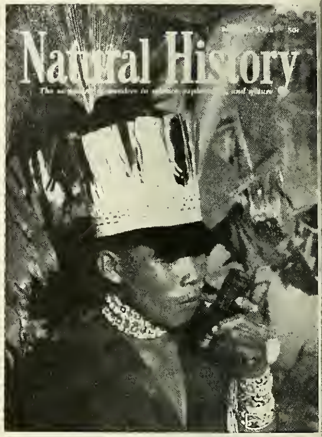

THE COVER THIS MONTH

The dressy, twenty-year-old Indian boy shown on this month's cover is Lucho Canaima, a member of the Conibo tribe. He is the son of Gustavo, who figures as the leading character in an article in this issue.

The Conibo Indians are a river people who inhabit the rain forests of the upper Ucayali in eastern Peru. Of all the tribes of the upper Amazon, they are perhaps the most skilled artists and craftsmen.

Lucho's costume reflects the Conibo's love of color and display. His diadem is made of egret plumes, the black tail-feathers of a bantam rooster, and the yellow feathers of the oropendola bird. The beads of his collar and bracelets were obtained from white traders, but the workmanship is native, as are the bracelets of howler monkey teeth. His forehead and hands are stained with Genipa, a dye made from seeds of the tree *Genipa americana*. He smokes a tubular pipe carved from a tropical hardwood.

The photograph was made in 1953 by Dr. Harry Tschonik, Jr., of the American Museum's scientific staff.

Publication Office: American Museum of Natural History, Central Park West at Seventy-ninth Street, New York 24, New York

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YOUR NEW BOOKS

TIGER OF THE SNOWS: The Autobiography of Tenzing of Everest with James Ramsey Ullman

Putnam, $4.50
294 pp., 26 illus., 5 maps

IN every generation there is a handful of professional mountaineers whose true love for the heights far transcends the fact that their very living comes from leading others to the peaks. These men would rather climb than eat, and the hissing of the wind in the guylines of a tent is music to their ears. In order to be truly happy, they must be pitting their skill and experience against the forces of Nature.

Tenzing Norgay, who conquered the summit of Mount Everest two years ago with Sir Edmund Hillary is one of these. As a youth, Tenzing tended yaks in the lofty Nepalese valleys at the very foot of Everest. Driven by an urge that even he could scarcely understand, he journeyed over the high Himalayan passes to Darjeeling as a young man to secure a job as porter on Eric Shipton's Everest expedition of 1935. Before he was 25 years old, he had already carried staggering loads to a height of over 27,000 feet on Everest's mighty northern ridge.

The book not only relates the thrills but also the triumphs and heartbreaks of Tenzing's career—the desperate ups and downs of an existence that depends entirely on the unpredictable whims of clients who travel halfway 'round the world to tackle the lofty peaks along the frontier between Tibet and India.

Almost everyone knows that Tenzing climbed Everest. Few know of his visit to Lhasa and the Dalai Lama, of his fantastic and tragic winter attack on Nanga Parbat, or of his tremendous ascent of the east peak of Nanda Devi in a desperate search for two lost French climbers. Nor do many know of the warmth of his family life, repeatedly interrupted by expeditions, large and small, to every part of the Himalaya.

Mr. Ullman had done a masterly piece of work in assembling, editing, and writing this wealth of information; he had done it for and with Tenzing, in a style that is at the same time both simple and authentic.

It is good so readable an autobiography has been written of the Tiger of the Snows, the world's most famous Sherpa. As the citation expressed it when Tenzing was recently awarded Honorary Membership in the Explorers Club: "Your life has been dedicated to the exploration and conquest of the greatest peaks on earth, and yours is a record of high-altitude mountaineering and fortitude unequalled in the history of Man."

BRADFORD WASHBURN

F. SCHULYLER MATHEWS' FIELD BOOK OF AMERICAN WILD FLOWERS

Revised and edited by Norman Taylor

G. P. Putnam's Sons, $5.00
601 pp., 30 colored plates, more than 300 black-and-white illus.

THIS Field Book, originally published in 1902 and reaching a sale of approximately 150,000 copies, has been one of the most helpful and widely used manuals for the identification of American wild flowers. Both the lay public and the trained botanist have found it invaluable for reference. Now that it has been revised and brought up to date by a competent editor, it should continue to stand high in the estimation of those interested in our native wild flowers.

This revision conforms to the recently published Gleason edition of Britton and Brown's Illustrated Flora. One notes some obvious changes in taxonomic family names. For example, the pea family stands as Fabaceae instead of Leguminosae, and newcomers are Cactaceae, the Caesalpinaceae and the Empetraceae.

The new edition has 30 color plates, bound together at the back of the book, compared to 24 interspersed through the pages of the first edition. Among these color plates are two of De Candolle's Flower-Color System, which will be helpful in color nomenclature. As a whole the color plates are good enough to aid materially in identification, but they would not qualify as outstanding floral color reproductions. There have been several reorganizations in format and presentation of data but the number of pages is approximately the same.

There is a more comprehensive color guide where flowers are labeled by color in an index to guide one to an early identification. The page headings have the page number and the vernacular name of the family, whereas formerly the pages were numbered at the bottom and headed by both vernacular and systematic family names.

Users of the old edition will miss Mathews' introduction and the frequent mention of the insects concerned in the cross-fertilization of flowers. It is to be regretted that only occasionally are these close associates of the flowers mentioned, because very often the insects are a helpful clue to flower identification.

One may safely predict that this Mathews' Field Book in its revised form will live up to the high reputation of its predecessor.

HAROLD E. ANTHONY

"THE CABIN"

- - - - by Walter Collins O'Kane

Drawings by Francis Lee Jaques
Wake-Brook House, Sanbornville, N. H.
$3.50, 246 pp., 13 illus.

AS YOU leave the bustling highway and tread along the woodland trail that leads to the cabin door, all the confusion and conflicts of the outside world fade in the gentle rustle of the leaves overhead.

Walter Collins O'Kane in the wonderful pages of this book has somehow managed to convey to the reader something completely outside the usual deadly pattern of nature writers. While the cabin itself remains a vague unassuming shelter in the woods, it comes to life as the author colorfully unfolds with delicacy and perception the rhythmic pulsation of the undisturbed woods. The cabin comes into being as part of the woods. It does not stand apart surrounded by well-kept lawns, flower beds, and gardens where nothing dares to grow except by permission and in a duly assigned place. Such trimmings would soon strangle the cabin as a place of simple faith and a haven of refuge.

Untamed things creep confidently up to the very threshold of the cabin that by natural weathering of the changing seasons has blended into its woodland surroundings.

The cabin shies away from discussions where world events and important personalities are involved. If it could speak, says Mr. O'Kane, the cabin would say that there must be some place in life from which to look abroad in tranquility, in confidence, and in faith. This comes as something of a surprise, as for years O'Kane was well disciplined as a newspaper and magazine reporter.

Rain in the city, we know, is impersonal and unpleasant, but the author here makes us feel that raindrops in the woods, alighting softly and warmly on your cheek, are wet caresses from a soft gray cloud above the tree tops, that there is something comforting about the sound of falling rain as it patters on the unobstructed roof.

There are sounds in the woods so much alike that it is difficult to distinguish one from another, but we never stop to think about it. There are seasonal sounds and some easily recognized. The pond in midsummer where countless peepers were calling not long ago is now silent except for the occasional twanging note of an old bull frog.

Summer is also the time of fulfillment when everywhere everything is striving to increase its numbers.

This is a good book about the simplest things, warm, consistent, and sensitive but never sentimental. The writing in *The Cabin* often borders on the lyrical; it is wholly absorbing and entertaining either for a few snatched moments or for several hours' reading.

It is attractively illustrated with exquisite drawings made by Francis Lee Jaques, which add geatly to its charm.

George G. Goodwin

THE UNDERWATER NATURALIST

- - - - - - - - -by Pierre de Latil

Houghton Mifflin Co., $3.50,
275 pp., 24 drawings, 15 photos

THE French title of this book, *L'Homme Chez les Poissons*, is more accurate than its English one, and may be translated as Man Among the Fish or, better still, Man in the Home of the Fish. One might even argue that the book should have been called Man at Home with the Fish. For that is exactly what the new free-diving apparatus—the waterproof face-plate, rubber flippers and aqualung—have made it possible to be. Equipped with these, a man can literally live with fish. Not for indefinite lengths of time, it is true, but long enough to make underwater observations of an hour or two at a time, which is long enough to see firsthand what actually goes on in the world of water.

Much of the pioneering in the new sports of skin-diving and spear-fishing, as well as the more serious business of aqualunging, took place on the Côte d'Azur of France, and it is with these events and the fishes of this area that the author concerns himself. He describes the fishes and tells what has been found out about their way of life by divers, practically all of whom were sportsmen primarily interested in spear-fishing. The results are disappointingly meager. Without the supplementary information, gathered from observations made by scientists on fishes in aquaria and by the ancient Romans on their fish-loving compatriots, the book would indeed consist mostly of descriptions of how to hunt various fishes and how they react when hunted.

The author says, "Until scientists dive under the sea like sportsmen, or sportsmen become scientists, we shall need books like this one to establish some sort of liaison between them." *Précisément*, M. de Latil! My great hope is that reading your exciting and, all in all, accurate book will make young people want to become underwater scientists, not hunters.

James W. Atz

SALAMANDERS AND OTHER WONDERS

STILL MORE ADVENTURES OF A ROMANTIC NATURALIST

- - - - - - - - by Willy Ley

with illus. by Olga Ley
Viking, $3.95, 293 pp

WHETHER you are a zoologist, botanist, anthropologist, or just an interested naturalist, Willy Ley's latest book, the third in the trilogy he calls "Adventures of a Romantic Naturalist," is a must on your reading list. In the first chapter, Mr. Ley has tied together some of the most esoteric facts about cave salamanders to unfold a fascinating mystery story that includes politics, people, and *Proteus* (the salamander).

Whether Mr. Ley is narrating a tale about little people, the snow men of the Himalayas, recent and fossil birds, or legendary trees, he maintains a high level of excitement and interest. Even if you are well versed in the facts he presents, you cannot help but admire the combination of scholarship, humor, and conversational style Mr. Ley uses to make his writing so readable.

Occasionally I was startled by minor errors among so many accurate facts. For example, the author implies that the European cave salamander, *Proteus*, is seen in flooded rivers that empty into the "Aegean Sea," instead of the Adriatic. Mr. Ley also says that the South American tortoise, the "jaboty" or "Testudo tabulata . . . occurs in the northern portion of South America but is mainly found in Central America." Actually the jaboty barely gets into Central America but is common in northern South America, east of the Andes.

But these notwithstanding, the book is certainly one that provides several hours of sustained intelligent entertainment. After reading this latest adventure of a romantic naturalist, those who have not read Willy Ley's *The Lungfish, the Dodo, and the Unicorn* and *Dragons in Amber* will want to do so. Those who have read them will hope that the author is preparing another series of romantic adventures.

Bessie Hecht

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THE CAVES BEYOND: The Story of Floyd Collins' Crystal Cave Exploration

------- by Joe Lawrence, Jr. and Roger W. Brucker

Funk and Wagnalls, $4.75
283 pp., 81 maps and illus.

THE Caves Beyond is a fascinating narrative of suspense and adventure. Joe Lawrence, Jr. is the most able leader of the National Speleological Society's Cave Exploration Expedition to the Floyd Collins' Crystal Cave in Kentucky. Mr. Lawrence has the knack of telling a story that interests his readers from the first to the last moment. Co-author Roger W. Brucker, a cave explorer and surveyor on this expedition, describes vividly the trials, tribulations, and successes of this first large-scale, well-planned expedition of 64 people.

The writers describe the intensive care they used in selecting the personnel, all specialists in their fields, and how they coped with the trying problem of maintaining supplies. They tell how they gathered their scientific information, making underground explorations under the most hazardous conditions.

However, there is some additional information that I believe would have added greatly to the reader's interest and the general usefulness of this account: first, a geological section of the formations in which the cave is found; second, a perspective drawing of the cave indicating the various passages, rooms, etc., and the positions of the different levels as far as is known in this cave system; and third, a plate showing some of the fossils characteristically found in these formations.

David M. Seaman

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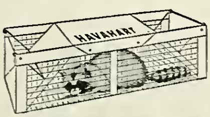

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BOWER-BIRDS

----------- by A. J. Marshall

Oxford at The Clarendon Press, $4.80, 208 pp., 26 plates with 64 illus., 2 general maps, 6 distributional maps

DR. MARSHALL's book on the nature and function of bower-bird behavior is, in effect, an exposé of one of the most perplexing phenomena in nature. Close relatives of the birds of paradise, the bower-birds comprise an aggregate of 18 species of small- and medium-sized birds, all of which are restricted to Australia and New Guinea. They are renowned for their extraordinary architectural abilities which, in some species, enables them to construct stages, huts, multipartitioned houses, towers, and in one instance an "Eiffel Tower" of sticks reaching a height of nine feet. These structures are decorated with bones, bits of clay, colored stones, fruits, flowers, trinkets, and feathers. In three species the inner walls are actually "painted" by the male owners. One mixes paint of a precise color and uses a special tool as a brush with which to apply it.

With considerable journalistic prowess the author describes the various aspects of his study. He reports that the Australian Satin Bower-bird builds an edifice which is ". . . a brilliant dash of colour on the otherwise sombre forest floor." Bower ornaments are often arranged and displayed in specific ways and articles of delicate color are replaced when they fade. In short, the behavior is little short of unbelievable, and it is quite understandable that the literature bearing on the subject should be shot full of anthropomorphic generalizations. It remained for the Australian author, a trained zoologist, now on the faculty of the University of London, to separate fact from fiction. His work is the culmination of 20 years of research in the field and laboratory. His book has a bibliography of 290 titles comprising virtually the entire literature on the subject. Also of note are many fine photographs, particularly those of Norman Chaffer.

Despite the very obvious popular appeal of this work, Marshall's studies are deeply gauged. Display, bower construction, "painting," color preference, and mimicry emerge as manifestations of innate behavior brought into play by the periodic influence of sex hormones. Indeed, several chapters are devoted to internal rhythms and the basic events which, in ways still incompletely understood, activate the complicated chains of reactions which in bower-birds reach such heights of expression.

E. T. Gilliard

APES, ANGELS AND VICTORIANS

---------- by William Irvine

McGraw-Hill Book Company
$5.00, 400 pp., 18 illus.

WHEN Darwin's patient and laborious heresy opened an abyss of liberalism squarely in the middle of the 19th century, it incited Benjamin Disraeli to give a spirited speech at Oxford with these words: "The question is this—is man an ape or an angel? I am on the side of the angels."

Apes, Angels, and Victorians is a recreation of the lives of Charles Darwin and Thomas Huxley, with particular emphasis on the furor that followed the publication of Darwin's *The Origin of Species.* The Church damned the *Origin* as heresy, and many heated debates over Darwin's theory of evolution rocked Victorian England and echoed around the world.

William Irvine gives us an insight into the innermost workings of these two great minds, not his own personal version, but the actual vivid details as he found them in published and unpublished records. Here is a colorful account of Darwin's voyage on the "Beagle" and Huxley's trip to the South Pacific on an antiquated vessel, the "Rattlesnake." Of the private life of Darwin, we learn of his courtship and marriage, of his interest in orchids, of his final recognition and honor. Surprisingly, we find Darwin as a shy though hardworking plodder who with infinite patience assembled masses of scientific data. His great epoch-shaking achievement, however, might well have sunk into oblivion without the eloquent Huxley at his side with his fiery tongue and his brilliant championship of Darwin's monumental work.

Great men of science, philosophers, and statesmen stride through the pages of this book, and some pause long enough to give us some idea as to what manner of men they were. We get acquainted with men, not just names, such as Cuvier, Hooker, Lamarck, Lyell, Macaulay, Spencer, Humboldt, Agassiz, Aristotle, Bismarck, Owen, Gladstone, Balfour, Kingsley, and Carlyle.

Darwin, like Huxley, lived in an eminent literary and political world as well as among the scientific men of his day. He was seldom overawed by great abilities but rather disturbed by great abilities combined with serious faults.

Apes, Angels and Victorians is accurate and well documented, with a useful index. William Irvine has carefully selected and skillfully arranged his material, making the book delightfully entertaining to read. In so doing he has fostered a new and enlightened interest in these these two great men.

George G. Goodwin

MR. GOULD'S TROPICAL BIRDS

- - - - - - - - Edited and with an introduction by Eva Mannering

Crown Publishers, $7.50, 24 colored plates, 12 x 16 inches

JOHN GOULD of England was a contemporary of Audubon and in many ways his counterpart in the Old World. The splendid color plates that illustrated the numerous folios of this energetic naturalist and promoter have in recent years come into high demand as wall pictures. As a result, whenever one of the Gould volumes, which were published only in small editions, comes on the market, it is usually snapped up by art dealers and dismembered. It is not surprising that many individuals wish to have a little closer knowledge of this remarkable man and his work. A few years ago a small selection of Gould's plates in much reduced size was brought out in England, with text by Sacheverell Sitwell, the noted author and connoisseur of objets d'art.

The present volume was also published in England, but the actual manufacture of the book and plates was at Frankfurt am Main, Germany. In size, the plates approach those of Gould's original folios, although the margins are somewhat less ample. Obviously great care has been taken with the color reproduction, and the thickness of pigment in many of the plates simulates the hand brushwork of the originals. Twenty-four of Gould's plates were selected for reproduction, but the choice seems not to have involved too much imagination. Perhaps one should not complain of the inclusion of six species of hummingbirds since Gould's five-volume monograph on this family is his most famous work, but with almost 3,000 plates to choose from, certainly there was no reason for including five kinds of trogons, colorful though they may be.

Eva Mannering has contributed an interesting though brief summary of Gould's life and activities. This account runs to four large pages and is followed by a page or two on which the brief paragraph that accompanied Gould's original plates have been reprinted. These accounts are a bit superfluous and dated, and some up-to-date information about the birds figured would have been more to the point.

In summary, the color work in this book is unusually good, and its price by present-day standards must be considered moderate. At the same time, a little more thought could have produced a book with wider audience appeal.

Dean Amadon

ADVENTURING WITH BEEBE

- - - - - - - - - by William Beebe

Duell, Sloan and Pearce.
Little, Brown and Co. $4.50.
283 pp., 16 half-tones

SELECTIONS from the writings of William Beebe are brought together in this volume, and covering more than forty years and ranging "from Bermuda to British Guiana and the Pearl Islands, from the tops of lofty jungle trees to a half mile beneath the sea."

The reader of this book will marvel at the breadth of interest displayed, at the selection of observations which add something to the currently accepted store of knowledge, and at the often unusual slant to the author's philosophy. To this should be added, as the host of readers already familiar with Beebe will attest, a mastery of prose that can make even the commonplace seem exciting.

William Beebe has a most responsive temperament wherever he encounters nature, and he could find topics that would interest the average reader on almost any field expedition he undertook. But he has a flair for picking out an area of study hitherto unexplored or for selecting a point of view or a technique whereby something new has been added. He draws on all the aids of science whether it be microscope, super-binoculars, airplane or bathysphere, and he has a loyal and enthusiastic staff.

There is variety in these samplings from Beebe's adventures, and this characteristic applies not only to the topic of the research but to the type of the adventure, which ranges from that of the explorer under no particular jeopardy to that of the pioneer into a field of great personal hazard, the ocean depths.

Eight pages of good half-tones help the reader to visualize events described in the text.

This is a book to read slowly and

continued on page 392

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Radioactiv

New

By

Alfred Toombs

OUTSIDE of Roane County, Tennessee, there are few people who have heard of White Oak Lake, a 36-acre impoundment of the waters of White Oak Creek. Yet, in a nightmarish way, it could be regarded as a kind of Walden Pond of the atomic age.

A bunch of elderberries, plucked

General Electric

▲ Atomic suit. This garish plastic uniform is worn by men who must enter danger areas in a plutonium plant.

GARBAGE"—

reat to man and nature

ecause of the insidiously poisonous waste products, idespread use of atomic power will call for continu-us sideline vigilance from scientists and naturalists

from a bush on the banks of this lake, will leave its image on a piece of film on which it lies for 24 hours. Plankton taken from the lake will be found to contain a measurable amount of radiophosphorous. The skeletons of the fish that swim in the lake—smaller than the same species found in near-by waters—have accumulated radiomaterials. The flesh of waterfowl that stay on the lake has been found to be radioactive, and a muskrat, trapped at the edge of the water, had a tumor.

For White Oak Lake has served as a dumping place for mildly radioactive waste from the near-by Oak Ridge Laboratory. Between 1950

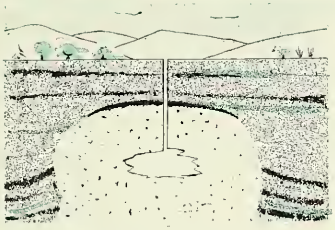
General Electric

▲ A CRANE OPERATOR'S VIEW of a "hot," 5-ton filter being lowered into a shielded box for interment.

Below: Bulldozers cover a coffin bearing contaminated machinery.

General Electric

Philip Gendreau



In the earth

Isolated areas like the Mojave Desert appear inviting as atomic garbage dumps, but naturalists would object. At left: An artist's conception of a saltdome being used as a crypt.

and 1953, an ecological survey was made at the Lake which illuminates, on a small canvas, a major question in our new age: How shall we dispose of radioactive waste?

The survey at White Oak Lake, like dozens of research projects sponsored by the Atomic Energy Commission, has served to outline the dangers that could be created by careless disposal of our atomic garbage. This problem is of particular interest to naturalists and conservationists, for it could involve a very real threat to our wildlife and to those unspoiled wilderness areas that still remain.

How much danger is there that atomic wastes will pollute our wildlife areas? Is it possible that vast areas of uninhabited land will be taken over for atomic graveyards? Can anything be done to prevent such despoliation?

It is at the Atomic Energy Commission that the answers to these questions can be found at present. For the AEC controls all fissionable material and is the custodian of practically all atomic waste in this country. At the present time, it holds in storage tens of millions of gallons of dangerously radioactive waste—while scientists try to find some reliable method of disposal.

Most of these wastes are produced when uranium is being processed into plutonium. More will be produced when uranium is "burned" for power. The wastes may be gas, liquid, or solid, and some of them may lose their radioactivity in less than a second. But others have a half-life—the period required for one-half of the atomic nuclei to give off radiation—estimated at tens of thousands of years. Cesium 135, regardless of temperature, pressure, or any other condition, has a half-life of two million years.

For fear that careless disposal of this waste might ruin parts of our planet for future generations, the AEC has been storing long-life material in steel tanks, heavily sheathed in concrete. Most is buried for the present in the ground at such installations as Oak Ridge, Tenn.; Hanford, Wash.; The National Reactor Testing Station, Id.; Savannah River, S. C.; and Los Alamos, N. M. Items buried in these atomic graveyards are carefully catalogued. Some trifling amounts of radioactive materials, heavily encased, have been dropped into the ocean depths.

But, in years to come, the volume will grow many hundreds of thousands of times larger, and some means of final disposal will have to be found for this vast concentration

General Electric

➤ Trenches are used to dispose of some liquid wastes at the Hanford plutonium plant. Unique filtering action of the terrain is said to eliminate the need for storage tanks.

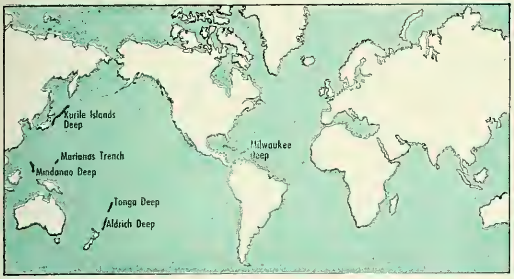
of lethal matter. The two general alternatives are to concentrate and contain the wastes or to dilute and disperse them.

Containment implies taking over land areas that would thereby be rendered useless. In trying to find such places, the AEC is inhibited considerably. It cannot dispose of atomic wastes in any area where valuable natural resources are apt to be discovered—and who knows what land, worthless today, may be considered invaluable a century from now?

Concentrated wastes will presumably be disposed of below the surface and far enough underground so there is no danger of contaminating the water table. For this reason, most caves have been ruled out. But there are natural salt domes, in which cavities could be created, which offer storage possibilities without danger of leakage. The oil industry disposes of saline waste in quantities much greater than those with which the AEC is dealing by pumping it back deep underground. Research has also indicated that certain shales and clays are capable of containing radioactivity so that it cannot re-enter the environment of man.

Currently, experiments are being conducted with a clay known as montmorillonite, which is extruded through a die in a form like spaghetti. Radioactive materials, absorbed in this clay and then baked, cannot be forced out. If areas can be found where the activated clay can be buried and locked into natural clay beds, one aspect of the containment problem will be solved.

Philip Gendreau

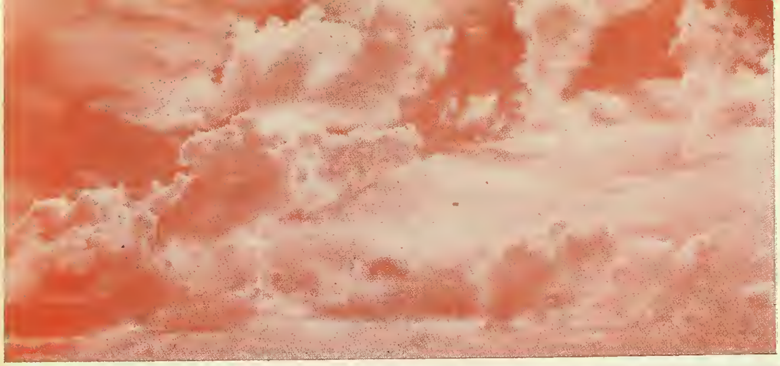


In the sea

Deep canyons in the ocean bottom have been considered as possible atomic garbage pits for concentrated loads. Some scientists maintain that the water there is so stable that little harm would be done even if sealed capsules were to leak. Others are much more cautious.

Brookhaven National Laboratory

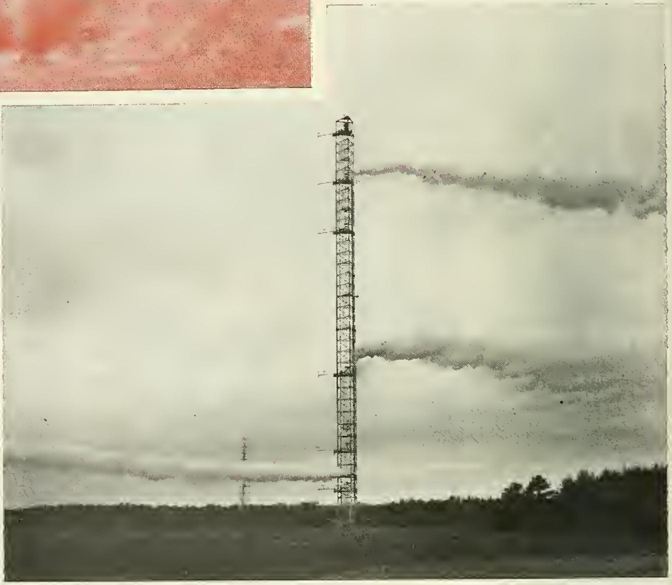
Oil drums lined with concrete and filled with radioactive wastes are hoisted aboard a Navy LST for burial at sea. This method apparently is satisfactory for limited quantities, but the advisability of large-scale sea-disposal is still being studied.



Black Star

In the air

"SMOKE RUNS" from a 410-foot tower (below) at the Brookhaven National Laboratory show when atmospheric conditions permit dispersal of air-coolant from an atomic pile. Note the unusual wind strata.



Three Lions

The bottom of the ocean has attracted attention as an area where concentrated loads of radioactive wastes might be deposited. All ocean life is believed to exist in the top thousand or so feet, and there are thought to be depths in the sea that have not turned over in 2,000 years. It has been suggested that plastic balloons, filled with waste, might be dropped into such depths on the theory that even if the material eventually escaped, no harm could be done. But 2,000 years is only about 60 human generations from now, and the idea of using the ocean as a dumping ground has met with opposition from some authorities. They point out that little is really known about the ocean—particularly about the relation of trace elements to aquatic life. Last year, a conference was held at Woods Hole, Mass., in which it was decided to undertake detailed research before going ahead with any extensive ocean disposal activities.

For those who are exploring the possibility of diluting the atomic wastes to the point where they are not dangerous, the ocean and all other bodies of water hold out an inviting prospect, of course. But there is hardly enough water in the ocean to solve the problem completely. For instance, it is estimated that it would take five per cent of all the ocean water simply to dilute the waste strontium 90 which will be produced by the end of this century—unless industry extracts and utilizes some of this material.

Such areas as the Mojave Desert and the Salton Sea, which are esteemed more by naturalists than by the rate-paying public, may appear inviting as atomic garbage dumps. These places, from the safety standpoint, may seem ideal for disposal, since they have no known outflow.

As a Government agency, the AEC can afford to take a slow and cautious approach to disposing of atomic waste. But what will happen when the atom goes on the market? Then the cost of waste-disposal may well represent the difference between profit and loss—the difference between using the atom as a cheap and abundant source of power or continuing with present sources. Under economic pressures there might be a tendency to relax the precautions.

Recently, it was proposed to build a power reactor in the Detroit area, under private auspices. An AEC official was horrified when informed that local authorities had cheerfully indicated they would allow the industries to dump radioactive material into one of the rivers in the Detroit area. If this reactor is installed, it will be built under safety criteria established by the AEC. But the incident illustrates the lack of understanding on local governmental levels about the problems of regulating disposal of waste. New York State recently became the first to adopt a code to cover disposal of radioactive wastes. California, Pennsylvania, and Massachusetts are devising such codes; but few other states or localities show any awareness of the problem.

It is the possibility of damage to the mechanism of heredity—"genetic damage" – resulting from pollution of air and water, that most alarms naturalists and conservationists. Fear has been expressed that

Encased in solids

➤ SPAGHETTI-LIKE clay (in the glass column) serves as a trap for "hot" atoms in radioactive liquid. This technique might reduce storage tank needs.

Brookhaven National Laboratory

radioactive materials may reduce the fertility of a species or cause abnormalities impairing its ability to survive. This is a touchy question around the AEC—which has been under criticism by some scientists, who say that experimental bomb explosions pose a danger to human survival. The AEC's thinking on the subject of danger to animal populations from disposal of wastes under present procedures is based upon observations in the Columbia River and elsewhere. These observations indicate to the AEC that there have been no "gross disturbances to aquatic populations" in the Columbia River. A 1951 survey in White Oak Lake maintained that changes in inheritance among natural populations "will be so small and so long delayed that they will have little significance from the conservation point of view."

However, the 1954 report states flatly that continued exposure to a relatively constant source of internal as well as external radiation, such as that received by the animals in White Oak Lake, even though at a relatively low level, would tend to increase the number of gene mutations during each successive generation. If this continued, it would in time definitely lower the average fitness of the population to survive, according to this report.

The report, in its conclusion, states: "It has already been pointed out that the rates of growth of the fishes in White Oak Lake were noticeably slower and the lengths of the life spans considerably shorter than those for the same species in near-by TVA waters. In addition, it was observed that two species of fish, the white crappie and the redhorse . . . had gradually disappeared from the lake during the three-year period of this survey."

But, in addition to the effect upon the germ plasm, constant exposure to even mild radiation may result in disturbance of the food web, many scientists believe. There will also be the tendency of certain organisms along the food chain to concentrate high levels of radioactivity—thus converting themselves into deadly little morsels for predators.

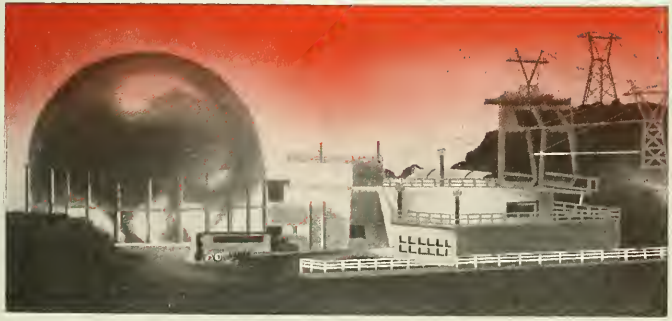
Atomic wastes create a special problem because of their insidious nature. Their poisonous quality is not necessarily noticeable. And the AEC has already learned that it is possible for waste to escape in spite of the greatest caution in disposing of it. At one AEC plant, it was discovered that uranium had somehow accumulated near a sewer outlet in sufficient concentration to create a potential hazard. In 1947, radioactive particles were detected near the separations plant at Hanford. They had been expelled from smokestacks, and it was necessary for workers to wear masks for several months. Atomic wastes that had been dumped into specially dug trenches in the Hanford area were found to be creeping slowly toward the Columbia River, creating the fear of contamination. Careful checks are still being made on this situation, although it is not considered dangerous.

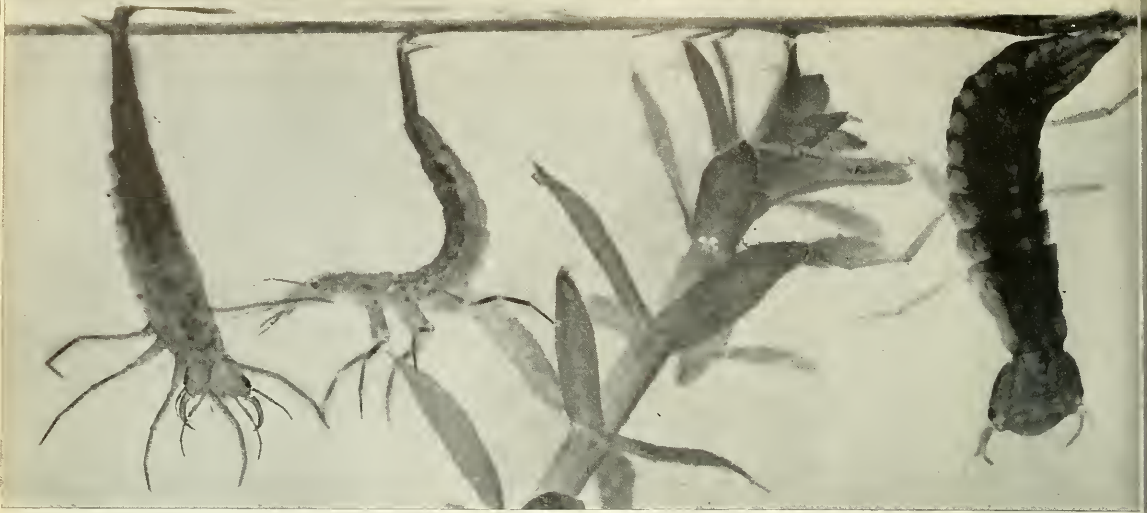
But these instances show how, in spite of the tremendous caution exercised by AEC, it is possible for mistakes to be made—resulting in hazards. The question uppermost in the minds of many AEC officials is what will happen when atomic waste disposal becomes a common industrial problem.

It is here that conservation and scientific organizations can work at present to combat effectively the greatest present danger of despoliation. For, unless proper safeguards are set up from the beginning, there exists the very real threat that the environment will be contaminated far more by atomic man than ever before in the history of industrial development.

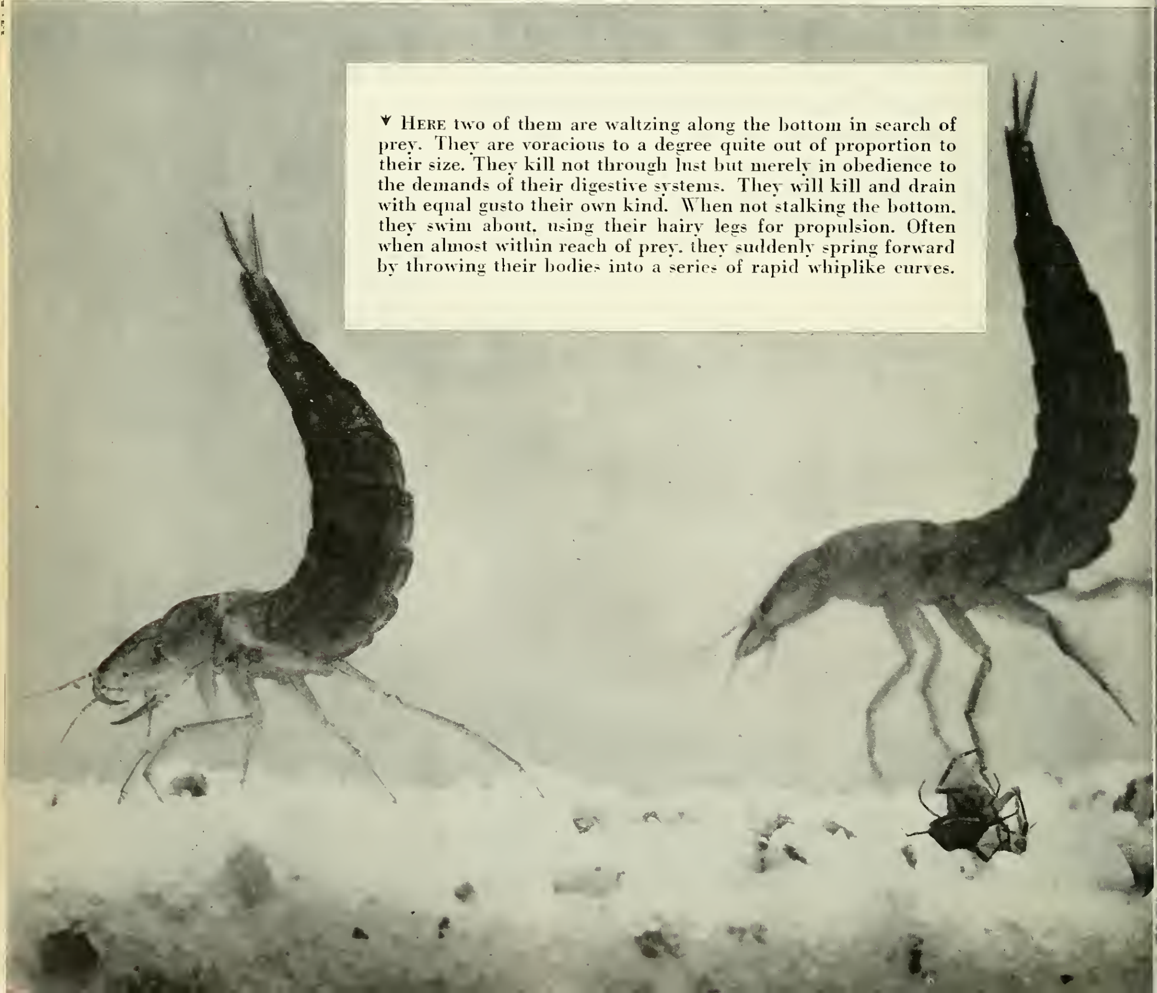
➤ POWER PLANT OF THE FUTURE? One designer's conception of an atomic installation includes a giant sphere for the heat-generating reactor.

Drawing of General Electric Model by Harry Cooney, AMNH





▲ APPROPRIATELY KNOWN AS WATER-TIGERS, these larvae of predacious diving-beetles a for the moment peaceful. They are taking in air through the tips of their abdome

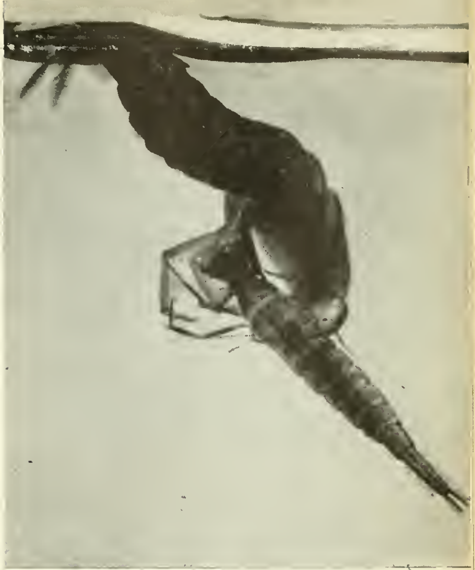


▼ HERE two of them are waltzing along the bottom in search of prey. They are voracious to a degree quite out of proportion to their size. They kill not through lust but merely in obedience to the demands of their digestive systems. They will kill and drain with equal gusto their own kind. When not stalking the bottom, they swim about, using their hairy legs for propulsion. Often when almost within reach of prey, they suddenly spring forward by throwing their bodies into a series of rapid whiplike curves.

Tigers of the Ditchwater

Dramas as tense as any in jungle or ocean depth are enacted under our very eyes

By Harold V. Green



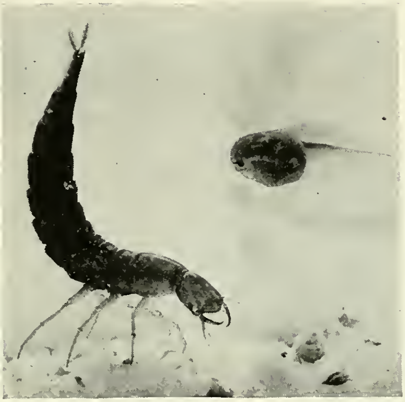
▲ **Here** a large water-tiger has captured a smaller brother. When full-grown, they are a little more than two inches in length.

EVERY boy has dreams of adventure. Occasionally, one does grow up to become a Frank Buck searching the jungles for strange animals or a William Beebe descending into the ocean to study the dwellers of the deep—but most do not.

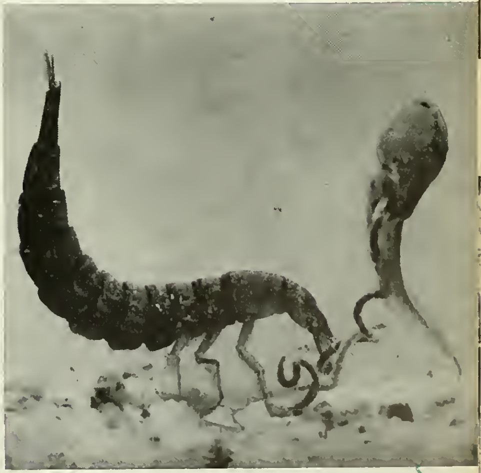
The average man, caught up in life's currents, pushes aside all thoughts of exploration as his 'responsibilities' grow. The adventurer's life is not for him. But how wrong he is; the jungles are no farther away than the weed-patches in his back yard; admirable oceans—in miniature—lie in near-by ditches. These tiny worlds, peopled by Lilliputians, are beneath his feet, often beneath his notice.

From the quills of the ancients came the expression, "*Natura maxime miranda in minimis*"—Nature is most wonderful in little things. An examination of the pictures shown here would seem to support this statement. These water-world killers were "discovered" in a roadside ditch, while I was on a "safari" in a near-by cemetery.

Anyone, anywhere, can have amazing adventures exploring among the multitude of fascinating creatures close at hand. Such journeys cost little, and the only hardship likely to be suffered is wet feet!



◀ **Tadpoles** are meat and drink to many denizens of the ditch-water deeps. Here is a dramatic tragedy in the making. The funny-faced tadpole has no way of recognizing the danger that lies ahead.

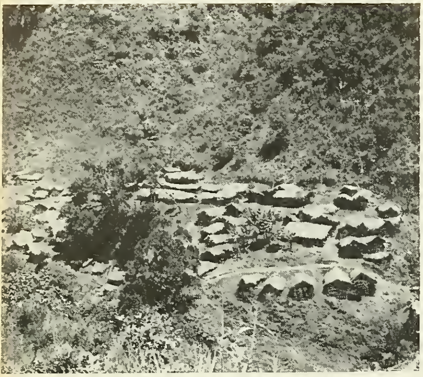


➤ **One less frog-to-be.** With an unbelievably rapid whiplike motion, the water-tiger has disemboweled the tadpole. The water-tiger is accustomed to striking hard enough to pierce the horny armor of its brothers and sisters or other insects; hence it has struck the tadpole an unnecessarily violent blow. The placid surface of many a pool conceals battles of this sort, chapter after chapter in an endless conflict that has gone on since earlier geologic eras.

Salt-Makers of New Guinea

The effort to which primitive people go to get salt reminds us how fortunate we are to have a salt cellar on every table

By Arnold M. Maahs



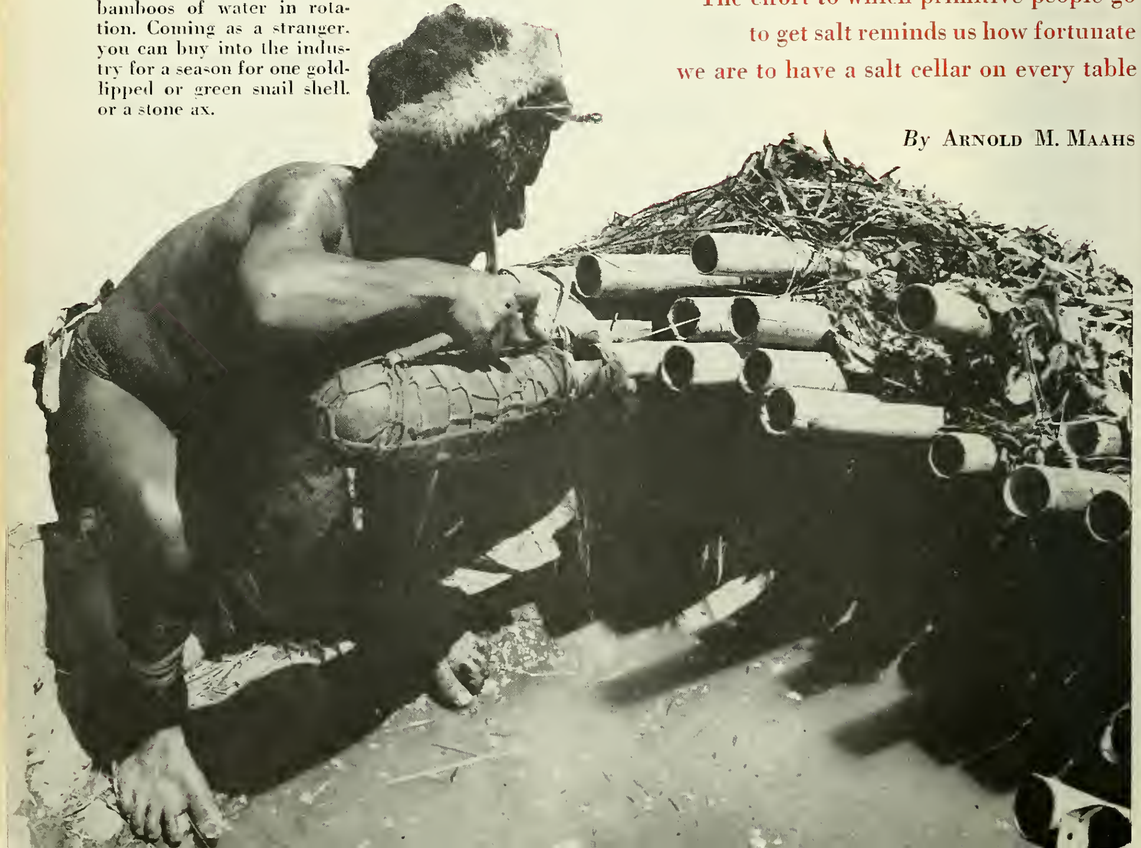
▲ A VILLAGE built on salt. A near-by spring yields only a repulsive sulphurous mess when its water is evaporated, but the natives have devised a method of refining it. They come here from their permanent villages to produce salt and barter it over an area of several thousand square miles.

IN the interior of New Guinea, a hundred miles or so from the sea, a trickle of water has brought fame to a native village. The village lies in the gorge of the Wahgi River and is noted for the production of salt. There the natives have developed an ingenious method of making salt from a small spring that comes out of the mountainside. Since New Guinea natives are always salt hungry, there is a ready market, and hundreds of natives are active in this primitive industry.

It is not merely a matter of boiling the water for its salt content. The natives must have tried that many years ago and not gotten salt. The water is sulphurous, and after evaporation, a sulphurous mess is left. It is not salt, nor is it palatable.

How do primitive people discover the complicated things they do? These people had to evolve a lengthy process, the origin of which is lost in antiquity, and which somewhere along the line eliminates the sulphur. Having no written language, they have passed the knowl-

▼ THE WATER is collected in bamboo tubes. Each visiting village takes four or five bamboos of water in rotation. Coming as a stranger, you can buy into the industry for a season for one gold-lipped or green snail shell, or a stone ax.



edge down by word of mouth.

Somehow the natives learned to collect grass and soak it in the sulphurous, salty water. Three kinds of grass are available, of which two are readily identified. The natives call these *iraun,* which is kunai, and *bualci,* which is couch grass. The third type is called *mincikul* by the natives, but I could not identify it.

The work of gathering and drying the grass requires about one month. Some of the people carry it many miles to the salt village, and it is all hard work. Then the grass is soaked in the sulphur water in pits that have been dug out of the soft rock. When the grass begins to decay, the salt village smells like a well-ripened manure pile.

The salt village is not the home of these people but merely a motley collection of huts built near the spring to protect the whole process from the weather.

While the grass is soaking, it lies under a shelter, protected against the rain. Next it is dried thoroughly by piling it in another shelter.

The grass is now ready for burning, and a hot wood fire is built. A stack of dry grass is put on it, which burns from the inside out. In time, quite a heap of ashes accumulates. The ashes are carried to the home village for the final process. Natives scoop them up very carefully and place them in a wrapping called a *karuka,* sewn of pandanus leaves. The long leaves have been laced together to form what resembles a blanket. The ashes are carefully placed on the karuka and folded in. Then, suspended from a pole, the karuka is carried home.

Since the salt village is in the gorge of the Wahgi River, the carriers must climb a mountain to get home, regardless of direction. This all adds up to more hard work.

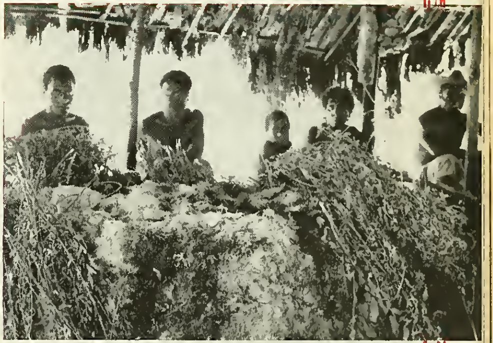
At the home village, the ashes are placed in a bark funnel, and water is poured over them. The seepage is drained into a bamboo container and later boiled. The natives have learned that the salt in the ashes will drain through and that by evaporating the water they will recover it.

Boiling water without a kettle or saucepan would seem a bit of a problem, but the salt-makers have solved it very nicely. They get a flat stone and place a banana leaf on it. An outer rim is built up of clay. The leaf is water-tight, and an excellent saucepan is the result. Each stone is used until the heat cracks it. Then the river bed supplies another. Since the stone is several inches thick, it gives an even heat and the salt is never burned.

Water is added to the stone saucepan and evaporated till a pancake of salt remains. One karuka-

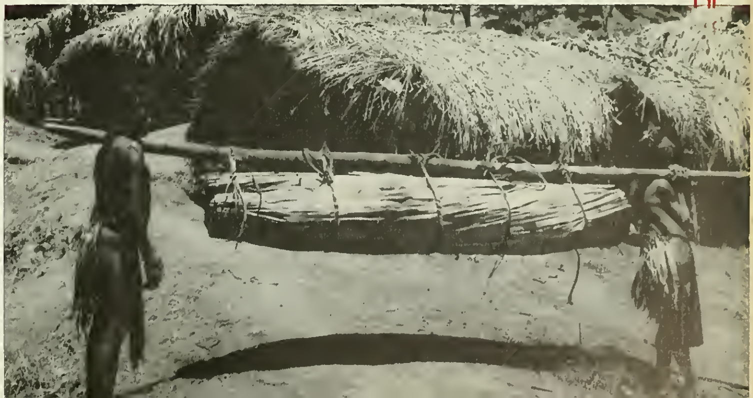
◄ GRASS is carried to the village in bundles and soaked in the water in a pit that has been gouged out of soft rock. The salt village can scarcely be considered a vacation spot, for the decaying grass smells like a manure pile.

➤ AFTER thorough soaking, the grass is dried.

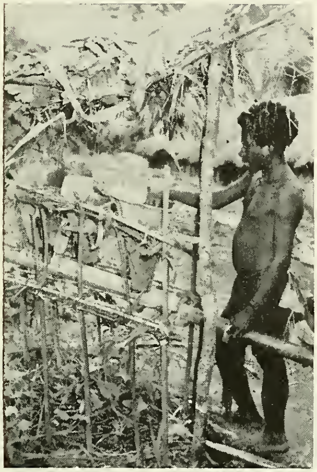


▼ IT IS THEN BURNED in huge piles. The ashes are carefully gathered up, and . . .

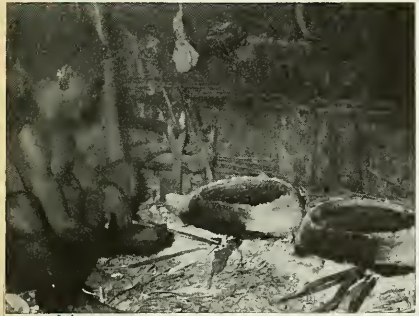
▼ . . . afterward wrapped in huge *karukas* made of pandanus leaves. These are carried to the permanent village for final processing. One karuka-load will produce five large pancakes.



load of ashes will produce five pancakes, equivalent in value to a very large pig. Occasionally a native will trade one pancake for a small pig. An extra-large batch of grass can produce six or even seven salt pancakes. But production is limited by the time and labor required. Natives told me that one man could produce five karukas of ashes or 25 salt pancakes in one year. But it would be full-time employment. Normally, the pigs and gardens form the main occupation of the natives, and they work at salt-making only in their spare time in the afternoon. The result is that an entire village will normally produce about 25 salt pancakes in a year.



▲ Back home, the salt-makers put the ashes in a funnel and pour water over them. The solution drains into a bamboo . . .

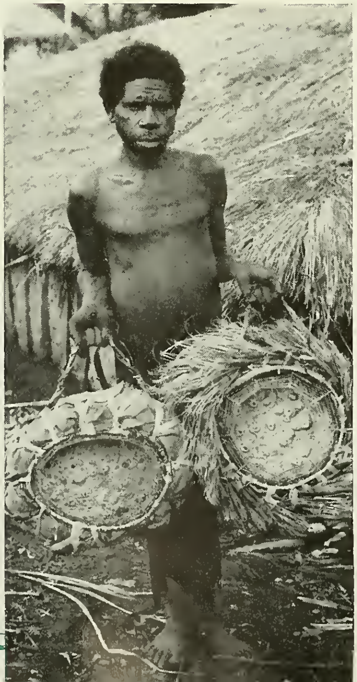


▲ . . . and is boiled on flat stones rimmed with clay.

Since the production of salt is such hard work and takes such a long time, the finished product cannot be sold cheaply. As one native expressed it, the price is "on top more," or very high. Though salt-making may be a local monopoly, another salt spring is found in the Wabag area, and it is likely that there are more than these two areas in the highlands where salt springs are worked. The present price of a disc of salt is 10 shillings ($1.40).

The division of water at the spring is regulated quite peacefully. Each village takes what it requires in rotation, perhaps five or six bamboos full. There are some quarrels but no real fights. The fact is that the salt-making is hard work and a lengthy process. If it were simpler, some tribe would have driven the others out long ago. The entire process from grass to salt takes about two months. And there is enough water to keep everyone busy.

It is even possible for a stranger to come in and make salt. He buys or rents a house in the salt village. One payment of a gold-lipped or a green snail shell, or a stone ax, enables him to share with the owner in the use of the soaking pit and the house. The owner can end the partnership whenever he wants. Rights of inheritance are decided by agreement; children inherit the rights from their parents and use the salt water in rotation.



➤ The result is these circular cakes of salt, valuable in trade far and wide, even in the little-known area to the south.

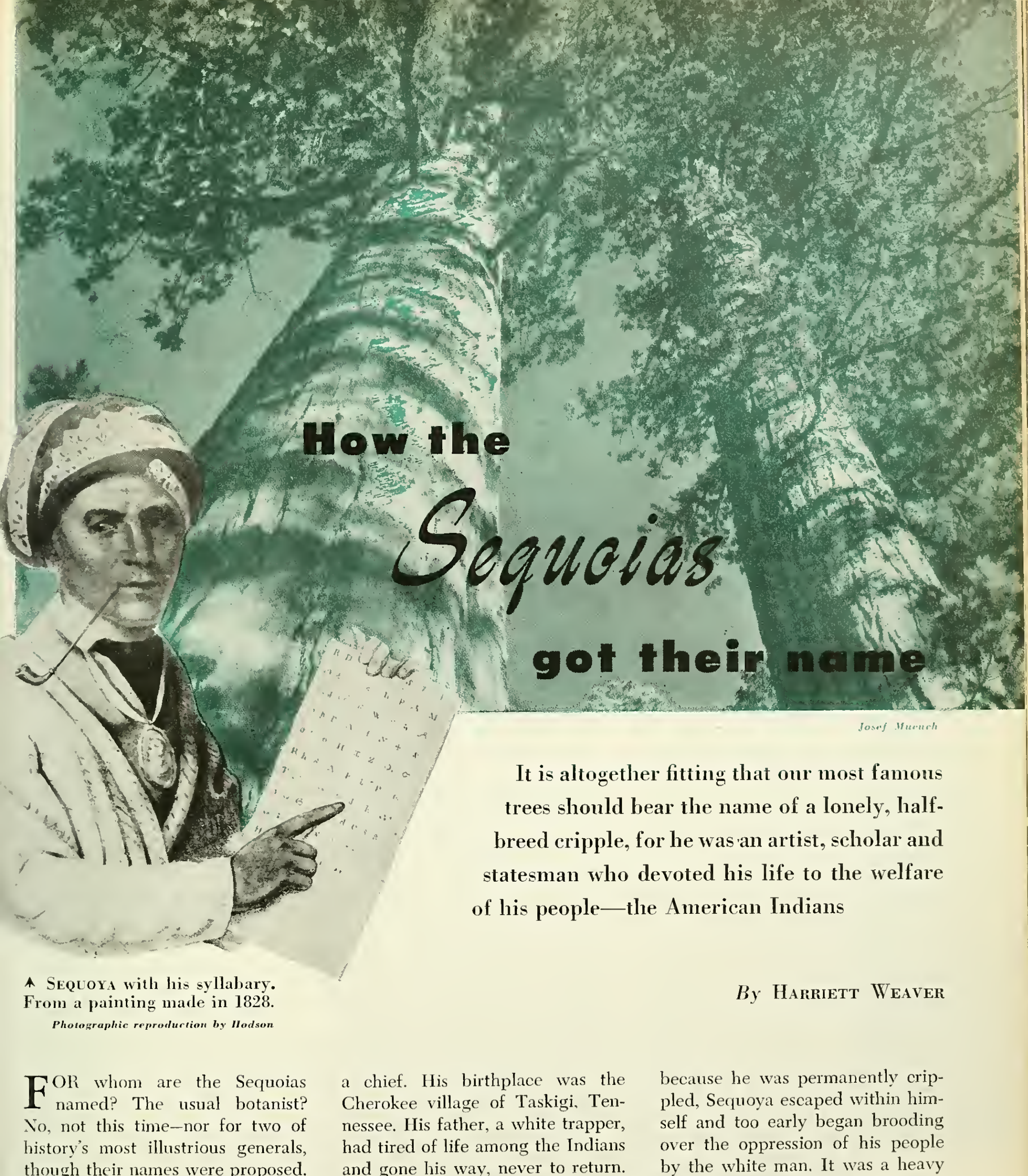
The supply of water remains constant through the wet season and the dry, and it is entirely possible that the natives may continue to make salt for many years. The clay pool fills every twelve hours. At night, a watchman is on duty and puts his foot into the pool occasionally to see how full it is. When there is danger of overflow, torches are lit and the water is stored in bamboos.

The salt makers feel that their product is made to be sold and is not for home consumption. They use the salt water for drinking and in cooking. The salt pancakes are distributed over an area of several thousand square miles, going into the uncontrolled area to the south about which white men know very little. Some of the buyers come to the Wahgi for the salt; others get it at distant villages through trade.

Over the mountains to the south, the people hunt the beautiful bird of paradise and trade the plumes for salt. The rate of exchange is one plume for one pancake. Cockatoo feathers are much desired for sing-sings or dances, as are hornbill beaks, which are tied around the neck. The salt buys pigs and shells. It is too valuable to waste on trivialities.

When the white man came to the Wahgi area, he brought salt with him, and where his influence has been felt for years, the native salt is rarely seen. But the salt makers are not likely to go out of business. The demand for Wahgi salt has always been greater than the supply. As long as the area is not over-supplied with white man's salt, the villagers of the Wahgi will continue their laborious business.

How the Sequoias got their name



Josef Muench

It is altogether fitting that our most famous trees should bear the name of a lonely, half-breed cripple, for he was an artist, scholar and statesman who devoted his life to the welfare of his people—the American Indians

▲ SEQUOYA with his syllabary. From a painting made in 1828.

Photographic reproduction by Hodson

By HARRIETT WEAVER

FOR whom are the Sequoias named? The usual botanist? No, not this time—nor for two of history's most illustrious generals, though their names were proposed. The distinction went to an American Indian, as gigantic in spiritual stature as the towering trees. His greatness of soul merits, now and forever, the tribute of mankind. This was Sequoya, the Cherokee.

Sequoya was born about 1760 (some say 1770) to an Indian woman of mixed blood, the daughter of a chief. His birthplace was the Cherokee village of Taskigi, Tennessee. His father, a white trapper, had tired of life among the Indians and gone his way, never to return. The young mother was blessed with extraordinary intelligence and did well in raising her son alone. In her company Sequoya found better companionship than among the braves of his own age, especially after he injured his leg and could no longer be active.

Rejected by his contemporaries because he was permanently crippled, Sequoya escaped within himself and too early began brooding over the oppression of his people by the white man. It was a heavy load for a small boy's shoulders, but it was fortunate for the Cherokees that he shouldered it, because there was need of sober thinking at this critical period.

As he reached manhood, Sequoya made a journey to the American Colonies. While he was there he beheld the wonders of the

Ray Atkeson

silversmith's craft. This he must learn so that he could fashion ornaments to delight his tribesmen! But how would he ever take the knowledge of tools, workshop, and techniques home with him? He had no way of writing all this down because he was illiterate. The Cherokees only spoke their language. There was just one way. He must store each detail in his mind.

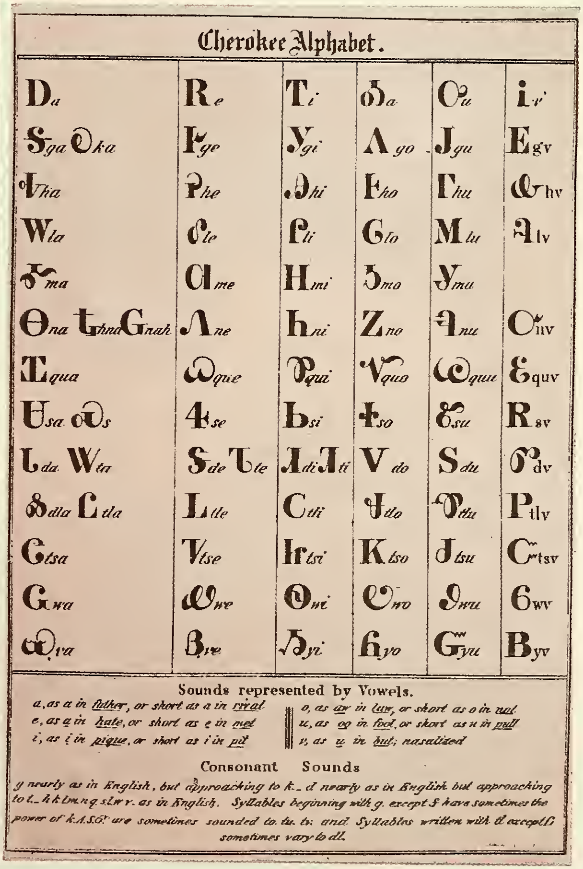
This he did, memorizing the craft so well that when he reached his village he was able to set up shop, make the tools, and go to work. The silver ornaments he created have never been surpassed in beauty of design and workmanship by any other eastern American Indian. His tribesmen, who had always pitied him, now came from far and wide to watch him and to stare in wonder at his skill. Great was their admiration. Soon they looked to him for strength and leadership, and even found themselves consulting him on matters of state. He began to feel that the welfare of the Cherokees was his personal responsibility.

In desperately seeking a way to better the tribe, he remembered something he had seen while visiting the Colonies. The people there were speaking to each other on paper. They made little marks on this "talking leaf" as he called it, and, afterwards, whoever looked at the leaf knew what had been said. One man had many leaves tied together, to which he often referred. There seemed to be a brotherhood among these men who could speak in this manner. Sequoya then became convinced that the Cherokees must meet the white man on his own grounds – with quick wits born of unity – and never again, futilely, with bows and arrows.

So at the council fire Sequoya spoke his thoughts and presented a plan to the chieftains. He proposed that the Cherokees create a nation with a governing body that would pass laws and endeavor to raise their standard of living, while he, himself, would give up his profitable silverworking business and devote his entire time to making a written language for the tribe. These things he felt would unite the Cherokees against the continual persecution by the white man.

At first the idea was almost beyond the vision of the high men of the council, but finally they ceased trying to dissuade him, and at the age of 49 Sequoya laid aside his beloved tools and began a task of such colossal magnitude that scholars of today look upon it with awe.

The English alphabet, as we know it, has come down to us through 30 centuries of develop-



Cherokee Alphabet.

Ꭰ a	Ꭱ e	Ꭲ i	Ꭳ o	Ꭴ u	Ꭵ v
Ꭶ ga Ꭷ ka	Ꭸ ge	Ꭹ gi	Ꭺ go	Ꭻ gu	Ꭼ gv
Ꭽ ha	Ꭾ he	Ꭿ hi	Ꮀ ho	Ꮁ hu	Ꮂ hv
Ꮃ la	Ꮄ le	Ꮅ li	Ꮆ lo	Ꮇ lu	Ꮈ lv
Ꮉ ma	Ꮊ me	Ꮋ mi	Ꮌ mo	Ꮍ mu	
Ꮎ na Ꮏ hna Ꮐ nah	Ꮑ ne	Ꮒ ni	Ꮓ no	Ꮔ nu	Ꮕ nv
Ꮖ qua	Ꮗ que	Ꮘ qui	Ꮙ quo	Ꮚ quu	Ꮛ quv
Ꮜ sa Ꮝ s	Ꮞ se	Ꮟ si	Ꮠ so	Ꮡ su	Ꮢ sv
Ꮣ da Ꮤ ta	Ꮥ de Ꮦ te	Ꮧ di Ꮨ ti	Ꮩ do	Ꮪ du	Ꮫ dv
Ꮬ dla Ꮭ tla	Ꮮ tle	Ꮯ tli	Ꮰ tlo	Ꮱ tlu	Ꮲ tlv
Ꮳ tsa	Ꮴ tse	Ꮵ tsi	Ꮶ tso	Ꮷ tsu	Ꮸ tsv
Ꮹ wa	Ꮺ we	Ꮻ wi	Ꮼ wo	Ꮽ wu	Ꮾ wv
Ꮿ ya	Ᏸ ye	Ᏹ yi	Ᏺ yo	Ᏻ yu	Ᏼ yv

Sounds represented by Vowels.

a, as a in father, or short as a in rival
e, as a in hate, or short as e in met
i, as i in pique, or short as i in pit
o, as aw in law, or short as o in not
u, as oo in fool, or short as u in pull
v, as u in but; nasalized

Consonant Sounds

g nearly as in English, but approaching to k._ d nearly as in English but approaching to t._ h k l m n q s t w y. as in English. Syllables beginning with g. except Ꭶ have sometimes the power of k. Ꭺ. Ꮪ. Ꮼ. are sometimes sounded to. tu. tv: and Syllables written with tl except Ꮭ sometimes vary to dl.

▲ THE CHEROKEE ALPHABET is the unique accomplishment for which Sequoya is known best. With its 85 characters, it provided a means of written communication for the Cherokee Nation. Parts of the Bible were printed with these strange symbols as well as a weekly newspaper, the *Cherokee Phoenix,* which first appeared in 1828.

ment, from Egypt, Phoenicia, and Greece. Almost overnight the entire Cherokee Nation was to become enlightened after this one selfless man dedicated twelve years of his life to the making of a syllabary.

All through these years, Sequoya worked alone and friendless, scoffed at by everyone, even by his own family. He was thought to be bewitched because of his endless and strange carvings on the tree bark. No one would have anything to do with him lest they, too, might become possessed of evil spirits. Yet he labored on, often working into the night by the light of a burning pine knot.

At the end of the third year, he had thousands of symbols—one for every word of the Cherokee language. Realizing that this would have no practical use, Sequoya then destroyed everything he had done and, undaunted, started all over again.

In the years following, he listened to his people as they spoke and so began to break down the words into sounds and units of sounds, or syllables. When he had finished, there were only 85 symbols—some of his own design and some that were English characters taken from an American newspaper he found beside a trail. His Herculean task was at last finished. Sequoya was ready to teach the writing to the Cherokees.

But no one would have any of it—not those mysterious signs—the workings of a demented spirit. The alphabet appeared to be doomed. And then two cocky young braves volunteered to be taught, though not sincerely to learn. They merely wanted to prove what everyone already thought—that Sequoya was mad. Much to their surprise, however, they discovered that the writing would work and that they actually could speak to each other on the leaves. On winged feet they sped back to their villages and spread the word. The redskins began pouring in from every direction.

Life for the Cherokees now took on new meaning. Learning to write became a passion that was even more intense than their religious zeal. All things were put aside while they mastered their written language — and within a few months, as a nation they were completely literate!

Parts of the Bible were translated into Cherokee in 1824, and the *Cherokee Phoenix*, the first Indian newspaper, made its appearance four years later. The tribal Congress, meanwhile, had passed laws forbidding drinking but advancing agriculture, so that it became common for an Indian to own a large herd of livestock. Loads of grain and tobacco were shipped down the Mississippi to market on flatboats; cottons and woolens were manufactured on a grand scale. It was the Golden Age for the Cherokee, and to climax it all, the White Father in Washington asked that a representative from the Cherokee Nation be sent to his Council Fire. Sequoya, of course, was chosen, and was received with honor and respect.

The Invasion

And then came tragedy. Gold was discovered in Cherokee country, and a horde of prospectors and settlers swarmed over the land, killing and plundering. Stock was stolen, grain was burned in the fields, Indian men were shot down in cold blood if they attempted to protect their families. The White Father was no longer friendly. His soldiers drove 13,000 Cherokees from their native soil to lands across the Mississippi in Oklahoma. Four thousand of them died on the way, and the survivors found themselves unwelcome intruders among kinsmen who had migrated there years before. Sequoya tried desperately to secure harmony, and he did unify them for a time, although their numbers were decimated and their spirit crushed.

Sequoya was well past 70 by now and wanted to live out his remaining years quietly, enjoying his hobbies. But a lifetime of service was too strong in him, and he began to dream of uniting all redmen in a common language. One summer day in 1843 he laid aside his garden tools and with the fire of a vision burning brightly within him disappeared into the unknown western wilderness, accompanied by a young brave. If they could just visit every tribe, listen to the talk, and make a written language that every Indian could understand!

Wherever Sequoya went, the Indians received him worshipfully and did their best to give him the elements of the language they spoke so that he might try to forge a universal tongue.

On and on Sequoya and the brave plodded, across the plains and the Rockies, through blistering sun, and wind and sleet, camping first in grassy lowlands and then among the crags of alpine peaks. It was too much for the youth. Somewhere along the way he gave out. Sadly Sequoya buried him and stumbled on his high trail alone.

No doubt sensing that he was on his last trail, the grand old man kept going, determined to find the lost band of Cherokees that had disappeared into Mexico long, long ago, when he was a boy. He wanted to find them and re-unite them with their brothers.

But what he sought was beyond all human endurance, and at last Sequoya became too weakened from old age and his indescribable hardships. Far away, in the Mexican Sierras he came to the end of his journey. Beside his campfire that night he listened in a half dream to the song of the coyotes on a distant skyline, and watched the smoke of his campfire curl lazily toward the stars. Reluctantly, the flame of his spirit flickered and went out, even as his campfire. The wind and the sands of time covered his earthly remains but left no marker on his resting place.

And yet—most magnificent of all monuments to the memory of a man's devotion, is the giant Sequoia, the living proof of life eternal, dedicated to an ideal which, like the great trees themselves, will surely live on through the ages to come.

Make Mine Vanilla

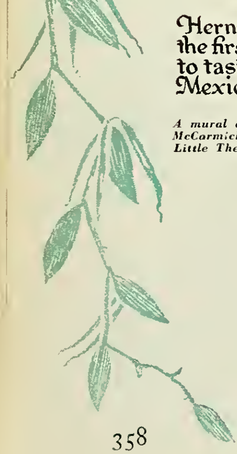
The story of America's most popular flavoring agent links the golden era of exploration with the modern age of chemical marvels

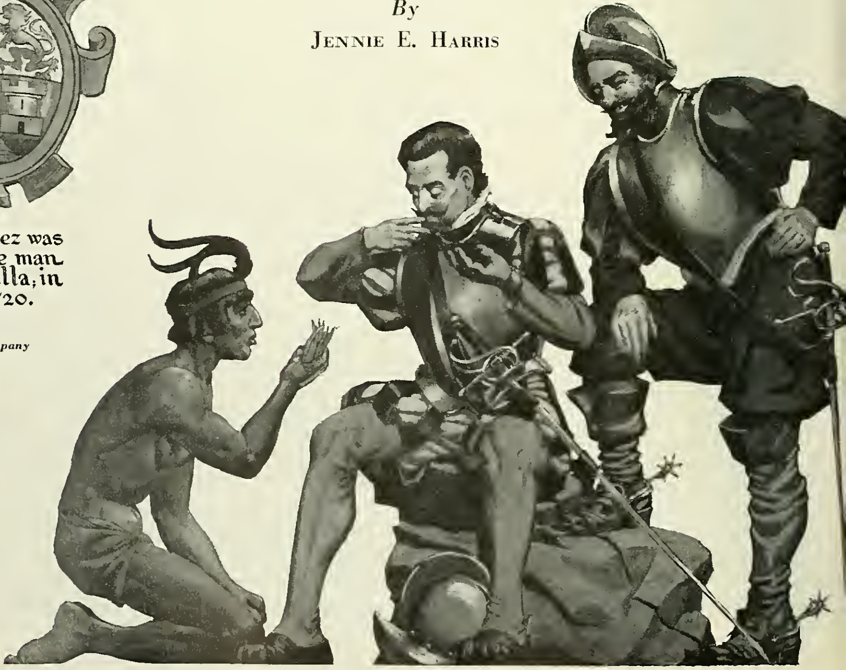
By
JENNIE E. HARRIS

WHEN the beautiful Mexican girl Marina became interpreter for her beloved Cortez, she told him about the wealth of Montezuma, King of the Aztecs, and about his city, Tenochtitlán, which Cortez was soon to behold. Cortez was interested in gold and silver, and he scarcely imagined that he was going to find something far more valuable. Little did he suppose that the gold and silver goblets that held Montezuma's favorite drink represented a wealth

Bernard L. Lewis, Inc.

▲ THE VANILLA PLANT is an orchid. On most plantations, the flowers are pollinated by hand.





Hernan Cortez was the first white man to taste vanilla; in Mexico, in 1520.

A mural at McCormick and Company Little Theatre far less important in the long run than the drink itself, *xoco-latl* (chocolate), and its extra flavor, *tlilxochitl* (vanilla).

Soon chocolate and vanilla were to win sensational acclaim in Spain, then in all Europe.

Francisco Hernández, in Mexico at Philip II's request (1571-77), drew pictures of the garlanding vanilla vine and named it "*Araco Aromatico*." Apothecaries in tiny shops in Europe sold the dark, cured, vanilla beans along with chocolate beans, to be used together. Because of the scabbard-like appearance of the pod, the Spaniards called it *vainilla* ("little sheath").

In 1602, Hugh Morgan, apothecary to Queen Elizabeth in England, sent some vanilla fruit to a man called Clusius, and he was the first to mention it in botanical literature. He seems also to have started vanilla off on its own as a flavor. "Chocolate needs vanilla," he said, "but does vanilla need chocolate?"

"Why should such a valuable plant grow only in Mexico?" people asked. It seemed to them that it should thrive in other tropical regions and make millions for those who grew it. Not grown from seed, perhaps; seeds were too tiny and stubborn. But why not from cuttings?

When Indians watched men take trial snips of the vine in Mexico, they hooted and jeered; "White man no make grow."

White man did make grow—after a fashion. Planters thrust vine-snips into warm earth under leaves, near saplings or stakes to climb on, and under tall trees for shade. They watched the cuttings root, grow, and thrust out tiny feelers, much as ivy does. Up they went: 15, 20 feet, even 80 feet if allowed; but only the hanging portions produced buds, so the men bent the vines downward, draping them over branches.

The buds burst into satiny beauty at early morning—true orchids, greenish yellow with six floral segments, one petal oddly lip-shaped. But by mid-afternoon of the day it bloomed, each flower was gone. And not a bean formed.

Bernard L. Lewis, Inc.

GATHERING THE CROP in Madagascar, where 63% of our vanilla is grown. Four to 20 beans hang in a group. The plants need saplings or stakes to climb on.

This was strange. Here were healthy vines with sturdy soil roots, sturdy aerial roots, and soft full flowers, but apparently these weren't enough.

In hothouses in England and in Europe, botanists watched the pale petals open, without perfume but most lovely. Then before three o'clock of the same day, the orchids would fade, and no beans would form. For 300 years after Cortez tasted vanilla, not a single vine grown elsewhere came to fruitage.

The trouble was that the short-lived flowers needed to be pollinated by stingless bees or other natural agents that did not exist where the plant was introduced. In 1836, Charles Morren of Liége got an inkling of this and experimented. He took pollen from under a protective part of the flower, and pressed it on the stigma of the same flower. His hunch proved correct; beans began to form, and before long they grew to string-bean length. There lay the answer to three centuries of failure. The frail blooms could not fertilize themselves; they needed special help.

With this knowledge of artificial pollination, France began cultivating vanilla on islands in the East

Bernard L. Lewis, Inc.

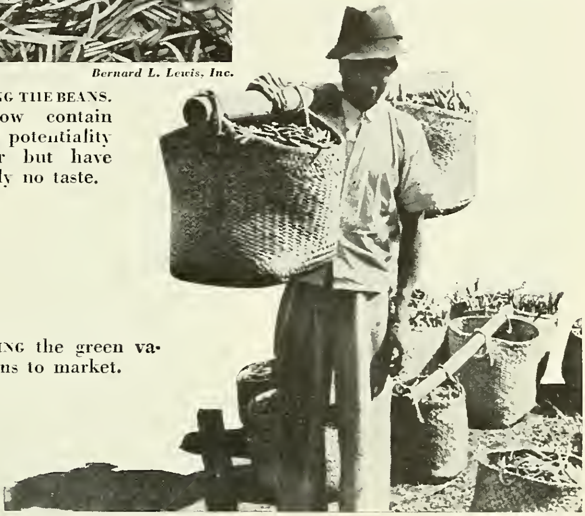
▲ Sorting the beans. They now contain their full potentiality of flavor but have practically no taste.

and West Indies, and on Madagascar.

A few years after Morren's discovery, a one-time slave, Edmond Albius, working on a vanilla plantation on the island of Reunion in the Indian Ocean, devised a better pollinating method. Even Mexico adopted this new method, and today vanilla no longer must wait for visits of a tiny undependable bee.

Vanilla planifolia is the vanilla most cultivated. The vines are grown along narrow aisles and hold clusters of buds, 15 or 20 to a shoot. Assume it is not yet eleven o'clock in the morning on a typical plantation. A quietness is upon the land; no wind stirs; but a few buds stir within themselves as they swell and push with growth. Gradually they thrust apart their crinkle-edged petals. Now they lie fully open. They would fertilize themselves if they could, but a sort of tongue formation keeps the pollen from contacting the waiting stigma. And since we are in a plantation far from the home of the vanilla plant, "midwives" must help. Down the aisles come women and children. Each pauses before the soft beauty of an opened flower and with a tiny bamboo toothpick lifts pollen from a golden mass and places it on the stigma of the same flower. Thumb and forefinger press for a moment to make sure the contact lasts. Then on to the next fresh flower.

Every morning for many weeks, hands gently hold the few more orchids that have opened, and the little wooden toothpicks go to work. If blooms depended upon nature for pollination, only a few beans might form, even where the vanilla is native. The vines flower twice a year, for about two months at a stretch, but no flower lasts a full



➤ Carrying the green vanilla beans to market.

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▼ A grower may sell some of his beans to one curer, some to another, in order to get the best prices.

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McCormick and Company photo

▲ At the beginning of the curing process in Madagascar, the beans are dipped in hot water.

day. Each must be pollinated by hand and at the hour when it is fresh and receptive. Only the largest orchids are treated, to assure quality vanilla and avoid overworking the vines.

Beans from autumn's pollinating hang mature in March, four to twenty in a group, six to ten inches long, pale green, then slowly browning. Workers move among them each day, gathering those exactly right, not too green, not so ripe as to be splitting. They pluck the stem with the bean, for beans must not be damaged in any way.

If you could taste a fresh vanilla bean you would discover it has scarcely any flavor. If left on the vine till sun-baked, it would smell like vanilla but make inferior extract. Only careful curing brings out the mellow aroma that means vanilla to every candymaker or cake baker.

Papantla is the curing center for the Mexican state of Vera Cruz. Here the planter takes his crop, offers it to this curer and that, selling only a portion to a single buyer because he wants the highest prices possible. The buyer would know which beans are healthier and best even if he were blind. Touch tells him as well as sight, and he has vanilla, you might say, in his veins.

For curing, the beans are sun-dried on large overlapping mats—fast enough to prevent mold yet not so fast as to sweat out the precious oils. (In Madagascar, they may first be immersed in boiling water.) *Camilleros* bring the beans out on stretchers on which they have lain indoors overnight. *Tentedores* place them evenly in rows on mats, one by one, quickly lest the sun grow hot. *Maestros* walk the narrow lanes, leaning over and testing each bean for dryness. Beans seldom dry alike. Young bell-ringers, *Campaneros*, ring for the helpers to come and collect the beans that have dried enough.

At midday, the beans are so hot they almost burn the fingers, and men fold blankets over them to make them sweat the rest of the day. At night, all the beans are carried indoors again and placed in blanket-lined, air-tight containers.

Every day for two weeks, this tedious placing and collecting must go on, with no bean touching another in drying for fear of spotting. Then, after the sweating process, two months of straight drying. Then 3½ months of drying in shelter, till the pods are dark brown or almost black, dry, and shriveled.

When fresh, they were as fat as your forefinger; now they are pencil-thin and have lost about four-fifths of their weight. But they are pliable enough for smoothing and massaging, for every bean must be straightened before bundling.

Bundling is an art. All the stem-ends must point in, all the flower-ends point out. Eighty to a hundred beans are placed in a bundle, and the outside beans are laid on carefully. Then the bundles are pressed, tapped on a table to straighten the ends, tied in the middle, boxed, and cased for shipment.

In France, and in our own food-specialty shops, people buy vanilla beans in glass tubes and grate them in their kitchens as our grandmothers did nutmeg. A recipe for floating-meringue custard may call for the grating of a "1-inch piece of vanilla bean." Dark specks in a dessert attest to the presence of pure vanilla. Most of the time, however, we buy vanilla extract, which is vanilla dissolved in alcohol, the solvent our government specifies.

Making vanilla extract

When the sweet-smelling boxes reach our shores, manufacturers further age the pods in tins in vaults under controlled temperature and humidity. Knives slice the pods to fineness (no grinding, for grinding would crush them, lessening their flavor).

Agitation over heat in alcohol and water follows – maceration (about the way we steep tea), or percolation (about the way we brew coffee). Filtering comes next. Then the extract enters a glass-lined tank for final aging. At last, color, aroma, and flavor are pronounced perfect, and the fluid is poured into sterilized bottles, to be labeled "Pure Vanilla Extract."

Here then is the source of pure vanilla: orchids pollinated by hand, the flower itself an ephemeral thing, with frail beauty; then the careful gathering of beans at the exact stage of ripeness; the painstaking curing and processing.

Strange that vanilla is not more expensive, for in only two places in

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Too rapid curing will encourage mold, too slow will sweat out the precious oils. After weeks of careful drying, the beans are bundled for shipment, as at right.

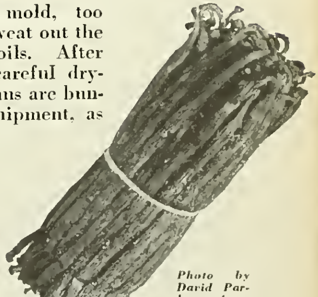


Photo by David Parlet, from McCormick and Company.

the world is it grown commercially to any extent: Madagascar and Mexico. And in Mexico, production is limited to a small region in the foothills and lower levels of the Sierra Madre Mountains in the states of Vera Cruz and Puebla. The country that was once the only place in the world where vanilla was known now exports almost its entire crop—mostly to the United States.

The U. S. imports 50 per cent of the world's production. A few beans come from British and French West Indies islands like Guadaloupe and Dominica, also from Indonesia and Tahiti. Some vanilla is grown in Hawaii. But by far the largest part of our import comes from Madagascar—the large island off the east coast of Africa that was known to the Arabs for a thousand years, the place that Richelieu described to Louis XIII as not belonging to anyone. Its soil ranks among the richest on earth. Madagascar produced 63 per cent of all our vanilla imports in 1952 (the last complete year for which the Department of Commerce has issued figures); Mexico produced 21 per cent, all other countries 16 per cent. Our total imports in 1952 were 1,400,069 pounds; in 1954 they were probably about 1,700,000 pounds.

The beans differ in quality so much that 21 different grades are recognized. Consequently, the price of the finished extract varies. You can buy pure vanilla made from Tahiti beans for about $1.25 a pound, whereas high quality extract from Mexican or Bourbon (Madagascar) beans would bring $7 to $10 a pound.

Vanilla remains the prime favorite among flavors and outsells all others—chocolate, orange, lemon, maple, cinnamon, coconut, clove, almond, banana, and cherry, to name a few. The supply fluctuates considerably: storms and disease take their toll of vanilla crops. Some vines produce continually for fifteen years, others only nine or ten. The land must rest 20 years before being replanted in vanilla.

The basic flavor in vanilla is vanillin (accent on first syllable). It reveals its presence on the outside of the pod in tiny needle-like crystals. Men call this white crystal efflorescence *givre* (French for "hoarfrost") and consider it a criterion of quality. The best pods have it. Actually, vanillin originates inside the bean. It is secreted by tiny hairs lining the inner crevices. Oil around the black seeds diffuses vanillin through the pod. Curing causes extrusion till fine white crystals of it coat the pod. About one-three-hundredth of the weight of the vanilla bean is vanillin.

Synthetic vanillin

When vanillin was discovered in oil of cloves in the last century, the Givaudin-Delawanna Corporation in Europe pioneered in the manufacture of a substitute for vanilla. The discovery was made chain-fashion: oil of cloves yields eugenol, which when treated becomes isoeugenol (used for synthetic carnation perfume); isoeugenol, further treated, becomes vanillin.

In the vanilla pod, other substances contribute to the full vanilla flavor. The numerous black seeds contain aromatic oils and a sticky flavorful juice. In tiny cells throughout the pod, volatile oils, sugars, gums, and many unknowns enter vanilla's flavor. Curing enhances these. The full mellowness of pure vanilla is, you might say, a rounded flavor, of which vanillin is only a part. To date, none of the other substances have been imitated.

Vanilla from orchids, vanillin from cloves, and lately vanillin from laboratories.

For years, the Monsanto Chemical Company made vanillin from Zanzibar cloves, then sought to create it chemically so as to have a source untouched by crop failure and price change. A substance called guaiacol, originally obtained from wood-tar creosote and sometimes used for treating chest and throat disorders, was to lead the way. Chemists had known how to synthesize guaiacol since about 1875, and in 1929, Monsanto began producing guaiacol vanillin. In 1931, the same company introduced an ethyl vanillin, trademarked Ethavan, which, though not identical to vanillin, is used as an imitation vanilla flavor. It is more potent than vanillin, and when properly used in commercial applications can be distinguished from vanilla or vanillin flavoring only by experts.

Guaiacol vanillin was in time succeeded by lignin vanillin, synthesized from the spent sulphite liquors from wood pulp mills. It was first developed in 1937 but has been manufactured by Monsanto only since 1953.

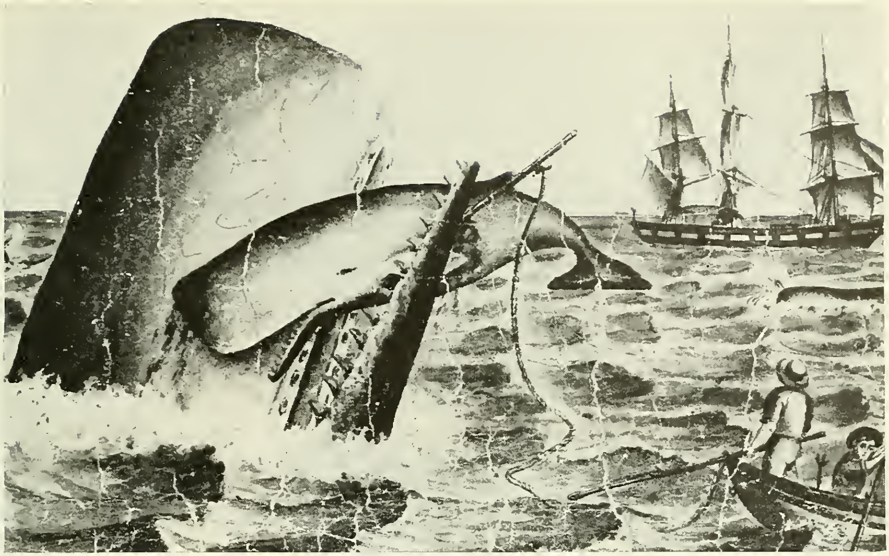
Some imitation vanillas contain only vanillin for characteristic flavor. Others contain pure vanilla as well. Each must be labeled "Imitation Vanilla," by mandate of our Pure Food and Drug Administration, unless the contents include 50 per cent pure vanilla, in which case "Vanilla-Vanillin Flavor" is allowed.

Imitation vanilla competes with pure vanilla because it is cheaper. Even in 1940, if you included all the commercial uses, the imitations outstripped pure vanilla five-fold, and the ratio may be 10 to 1 now. But the pure product retains its adherents. As one housewife put it, "All those extra, delicate, natural flavors in the bean make pure vanilla a veritable bouquet."

Women's magazines term vanilla "food perfume"—both a flavor in itself and an enhancer of other flavors. They advise that it be treated like a perfume, kept in a dark bottle, tightly stoppered, in a cool place. This is because air and light alter its precious aroma.

Four squares of chocolate, a teaspoon of vanilla — remember? Fudge, hot chocolate, cake icing, sauce for your vanilla ice cream. Thank Montezuma and his people for both the chocolate and the vanilla.

Additional information on vanilla and an extensive list of other published sources can be found in Donovan S. Correll's admirable "Vanilla—Its Botany, History, Cultivation and Economic Import," in *Economic Botany*, October-December, 1953, pp. 291-358.—Ed.



▲ The thrill of the chase was mixed with pathos when a scene such as this was enacted.

A Whale and her Calf

Ponderous evidence of what a mother will do to save her young

By Philip Purrington,
Assistant Curator, Old Dartmouth Historical Society and Whaling Museum, New Bedford, Massachusetts

It is perhaps inevitable that the vast whale will some day occupy the psychoanalyst's couch and give up more secrets of animal behavior. And when all is known, it is not unlikely that mother-love will prove to be Leviathan's most compelling instinct.

The accompanying illustration might seem at first glance to show a large whale lunching on a smaller one; but actually, it is a dramatic portrayal of what a mother sperm whale will do to rescue her calf. The great whaleman, Scoresby, actually describes such a scene: "In 1811, one of my harpooners struck a *sucker* [a suckling calf] with the hope of leading to the capture of the mother. Presently she arose close to the 'fast boat,' and, seizing the young one, dragged about 600 feet of line out of the boat with remarkable force and velocity . . ." Charles Nordhoff (the elder) in his *Whaling and Fishing* (1856) gives a long account of the behavior of the mother whale in protecting her young.

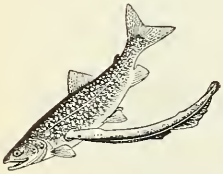
New England whalemen knew well that the mother will scorn safety while her offspring lives, and they often unfeelingly took advantage of her refusal to flee, as shown in this picture. There was some difference of opinion as to whether the cow or the calf should be harpooned first in a situation like this, but all agreed that the mother was a dangerous adversary at this time and should be approached with caution. As one whaleman remarked, "I didn't know the whale was within 50 fathoms of me, when up she went—and there ain't enough left of the boat to kindle the cook's fire!"

Many land animals from cats to bears carry their young in their mouths, but the sea mammals have a more difficult problem, because they have to breathe air and the young must be held at least partly out of water. It is interesting that the mother's instinct should be developed to take this into account. I am reminded that Natural History Magazine once reported a case that was observed at Marine Studios, Florida (January, 1940). When a young porpoise died one night as the result of injudicious feeding, its lifeless body was found the next morning being supported at the surface by the parent, presumably so that if life yet remained in the porpoise, it could breathe the necessary air.

The picture reproduced here is a water color in the collections of The Old Dartmouth Historical Society at New Bedford, Massachusetts. There seems little doubt that the artist was portraying a scene actually witnessed.

Man
and Nature

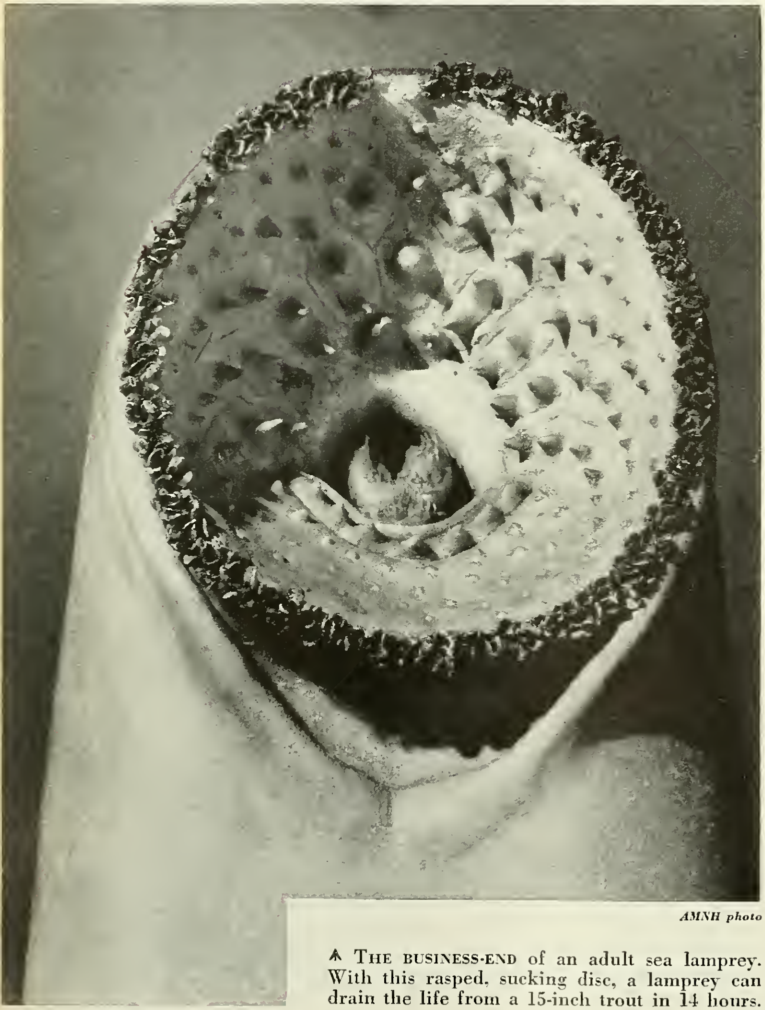
New Weapons against the Lamprey



Electricity, poison, and an international treaty are brought to bear on the voracious bloodsucker that threatens the existence of the lake trout

By Woodrow Jarvis

All photographs by the author unless otherwise credited



AMNH photo

▲ The business-end of an adult sea lamprey. With this rasped, sucking disc, a lamprey can drain the life from a 15-inch trout in 14 hours.

ONE day not long ago, two five-inch larvae of the sea lamprey died in a glass jar in a small laboratory in northern Michigan. This in itself was not unusual. Thousands of larvae had died in the same way. What caused an unusual stir and excitement was this: Two rainbow trout fingerlings and two bluegill fingerlings swimming in the same jar were still alive and active after the lampreys died.

The jar contained plain lake water holding five parts per million of an obscure chemical compound. Obviously, some quality of this compound was fatal to lamprey larvae and not to the other fish.

Outside the laboratory walls, Lake Huron's green waters lapped restlessly at the shore. Beneath the surface of those waters raged a continuing and terrible devastation, the lethal, parasitic attack of the swarming sea lamprey against the mighty Mackinaw trout and other Great Lakes food fishes of tremendous value to man.

The experiment in the glass jar represented the fourth and possibly the final approach by research biologists to destroy the lamprey so food fishes could survive. As readers of Natural History will recall,* the sea lamprey first invaded the upper Great Lakes basin in the 1920's. Formerly it was excluded by the natural barrier of Niagara Falls, but man unwittingly helped the lamprey around the falls almost a century earlier with the opening

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*See "Is the Lake Trout Doomed?" by Ben East, Natural History, November, 1949.

▲ The laboratory of the U.S. Fish and Wildlife Service at Hammond Bay, Mich., where weapons to destroy the lamprey are being developed.

WARNING!
DANGER
HIGH VOLTAGE
DO NOT GO BEYOND
THIS POINT

▲ A fisherman's-eye view of a weir on Pendill Creek emptying into Lake Superior. There are 44 such weirs on the American side of Lake Superior; others are being built on the Canadian side.

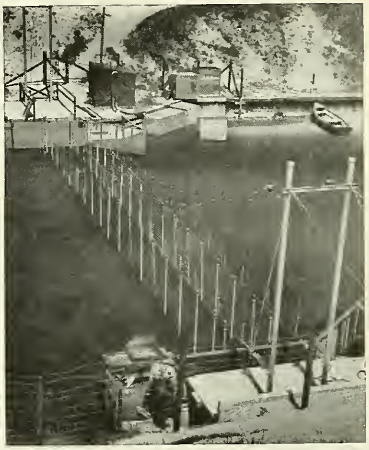
of the Welland Canal in 1829. This created a passage from Lake Ontario, where the sea lamprey is native, to Lake Erie and the upper Great Lakes basin.

The lamprey was slow to take advantage of the route, possibly because Lake Erie is in all ways inhospitable to its growth and reproduction. The lake is too shallow and warm, and it lacks the swift-flowing silt-and-gravel watershed streams necessary for successful spawning. But in the upper basins, the lamprey found a succulent hunting ground of rich food, deep water, and perfect spawning conditions.

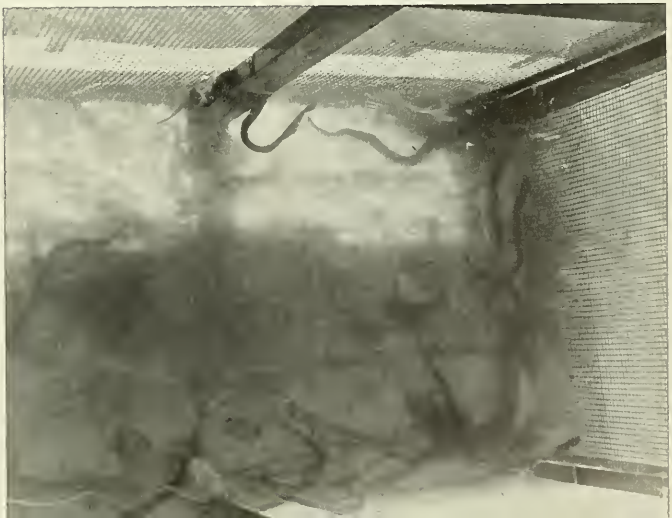
Lampreys became established in Lake Huron in the late 1930's and in 12 years destroyed the lake trout there. The annual catch by commercial fishermen dropped from 1,372,000 pounds in 1939 to 25 pounds in 1951. The dreadful carnage was repeated in Lake Michigan in only nine years, where fishermen reported 5,650,000 pounds in 1945 and less than 400 pounds in 1954.

And now, in Lake Superior, the same terrible slaughter seems to be pending. Scientists make this prognosis on the basis of the scarring rate i.e., the annual percentage of commercially netted fish that carry scars from lamprey attacks. Total destruction of trout in Lake Huron was accompanied by a 30 per cent scarring rate, in Lake Michigan by a 50 per cent rate. In Lake Superior the scarring rate has climbed with frightening speed in

➤ An electromechanical weir on the Ocqueoc River near Rogers City, Mich., which has captured 88,000 lampreys in six years of experimental work. An electrical field created by the suspended electrodes causes fish to enter the liveboxes on both banks.



▼ About two-thirds of the lampreys swim into the traps. The others attempt to fight their way through the field and become paralyzed in the eddies around the electrodes, where they are fished out by attendants with dip nets.



the past three years, and last year a count in one small area revealed a scarring rate surpassing 30 per cent.

Despite this, however, the yield of trout from Lake Superior has not been greatly reduced. In 1953, the catch for both American and Canadian waters of Superior was 3,784,000 pounds, compared to a 20-year average of 4,444,000 pounds. Experts say two significant factors are not reflected in these figures, though. The size of the catch has been maintained only through heavily increased fishing and through the use in recent years of nylon nets, which are said to be two to three times more efficient than cotton and linen nets.

From experiences in Lakes Huron and Michigan, fish biologists have learned to anticipate what they call an "explosion" of lamprey population in a newly-invaded lake. When that occurs in Lake Superior, the lake trout there have only a few more years to survive.

This is bad enough, but there is more. Biologists are counting on the Lake Superior trout to provide eggs for restocking Lakes Huron and Michigan. If the Superior trout are destroyed before the lamprey is stopped, the restocking program may suffer a staggering setback. Next to Superior the best source of supply for lake trout eggs is Great Slave Lake, in Canada's Northwest Territories, beneath the shadow of the Arctic Circle. Since 1946, Canada too has been studying the lamprey, and is experimenting with an airlift of lake trout eggs from Great Slave in case the lampreys win the battle for Superior.

How should we attack these swarming parasites, spread across 77,000 square miles of water ranging to a depth of 1,290 feet? Where and when are the lampreys vulnerable? The state of Michigan started looking for answers to these questions in 1946. The State Department of Conservation assigned a young fishery research biologist, Dr. Vernon C. Applegate, to the project. For his researches, Applegate selected the Ocqueoc (ahk-yok) River, which empties into Lake Huron in northern Michigan near the Straits of Mackinac.

A Test Stream

The Ocqueoc was one of the first major lamprey spawning streams studied in the Lake Huron watershed. The water was swift and of the proper temperature. There were extensive gravel beds for the lamprey nests, in which a female could deposit her average 62,500 eggs. Downstream from the gravel beds were broad silt banks and flats where the larvae could burrow for their sedentary stage, which lasts from four to six years. The stream provided sufficient spawning area for about 8,000 pairs of lampreys, and the survival rate of the larvae was about one per cent. With such a contribution from a single stream, it was not surprising that the "explosion" came.

Applegate found that natural checks were operating to some extent on the lampreys, but not sufficiently to hold any hope at all of less than saturation spawning. He noted that late arrivals were even destroying and reworking the nests of early spawners. Later studies, after a mechanical weir was built across the river to trap the lampreys, added to the gloomy picture. In one year the weir trapped 25,000 of the ugly creatures on their upstream spawning run.

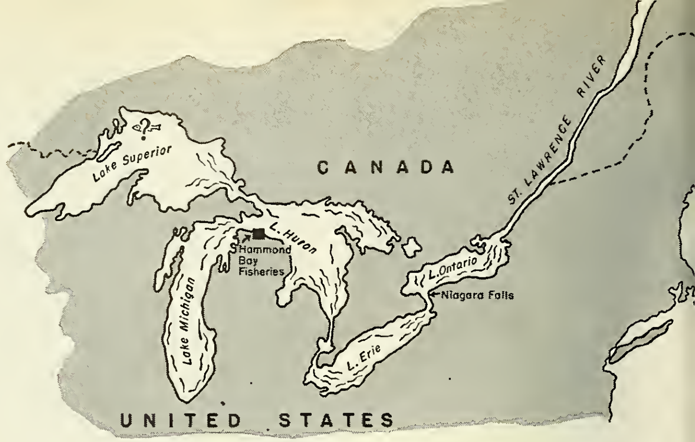
In 1950, the U. S. Fish and Wildlife Service was directed by Congress to devise means of controlling the lamprey. The Service launched an expanded program of research under the direction of Dr. James W. Moffett. Applegate was placed in charge of field studies. Four methods of attack against the lamprey were considered, but two were eliminated after experimentation.

Introduction of natural enemies —vertebrate, viral, or bacterial— was considered too risky. An experimental inclined dam to trap downstream migrants at the start of their adult life proved too costly.

More promising were the other two methods: weirs to trap spawning runs in the streams, and poison to kill the larvae in the streambeds. The first experiments with poison were started in 1951, when a scholarship was granted a graduate student to investigate the possibilities. Applegate meanwhile concentrated his efforts on means of trapping the spawning runs. This was believed to be the method promising the quickest results.

Starting with a purely mechanical weir, Applegate added electricity in 1952 and developed an electromechanical weir. These weirs employed a single, double, or triple row of electrodes—depending upon stream conditions—suspended by a cable so they would hang vertically within a few inches of the stream bottom.

Under ideal conditions, both lam-



▲ THE WELLAND CANAL permitted the sea lamprey to circumvent Niagara Falls. In Lake Erie it didn't become a problem, but it destroyed Huron's lake trout in 12 years, Michigan's in 9.

▲ **Biologist Applegate** demonstrates that lampreys will attach themselves to anything, including humans. They will not actively attack warm-blooded creatures, however. To break the suction, you seize the lamprey just behind the head and squeeze.

▲ **Lampreys** gathered in test weirs are weighed and measured. This is part of a morning's catch in the Ocqueoc River weir.

▲ **Lamprey larvae** for tests are shocked out of silt beds in the Ocqueoc with electrodes powered by a portable generator. They are netted and stored in a concrete tank at the laboratory.

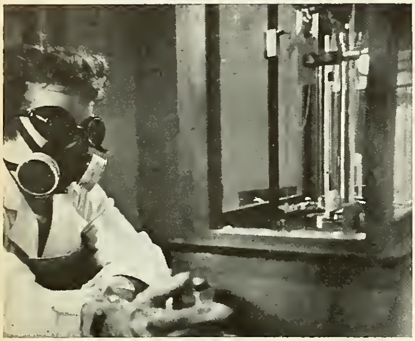
➤ **Rainbow trout** and bluegill fingerlings are supplied by Michigan hatcheries and kept in outdoor raceways until needed.

preys and spawning fish, such as rainbow trout, were repelled by the electrical field and diverted into liveboxes on each bank of the stream. There the lampreys were caught and destroyed; other fishes were released upstream to continue their spawning cycle.

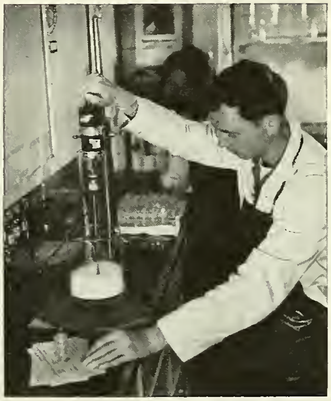
Some lampreys tried to bull their way through the electrical field. These were paralyzed and collected on the bottom in eddies about the electrodes, where they were removed with nets or spears and destroyed. Other lampreys turned back to the big lake, where they died without spawning.

Applegate himself admitted that

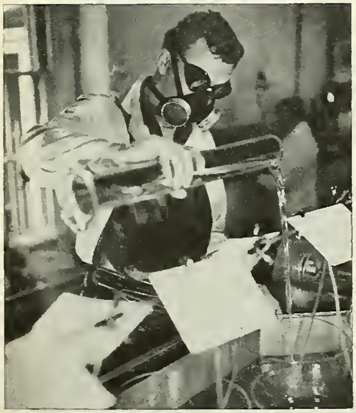
➤ Two lampreys, two bluegills, and two rainbow trout fingerlings are placed in each testing jar. The laboratory tested 50 compounds a day. The jars are placed in a water bath held to a constant temperature of 55° F.



◄ Chemicals used in the tests are weighed to 1/1000th of a gram by a laboratory technician. Some of them are deadly, so the technician takes no chances. She dons goggles, mask, gloves, and apron before starting work.

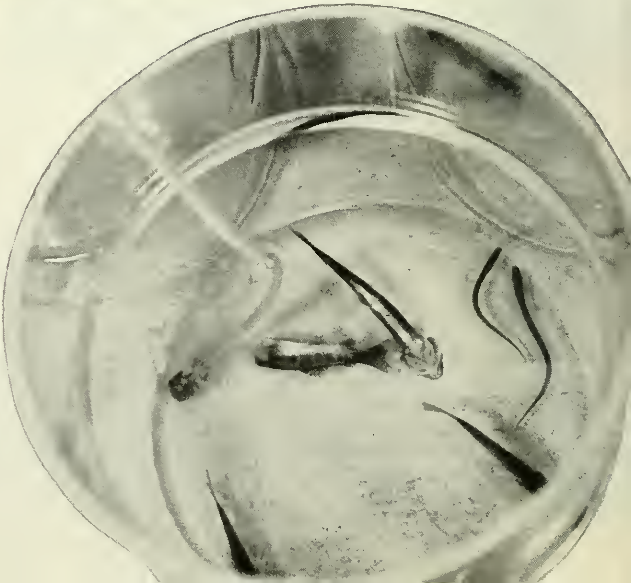


➤ An electric mixer dilutes the chemicals with water to a proportion of five parts per million.



▲ Test solutions are added to each jar, and identifying notations are made on file cards clipped to a wire.

➤ A typical test. After four hours, the rainbows are dead with gills extended and the bluegills are sluggish, but the lampreys are as lively as ever. This particular compound obviously showed no promise.



the electromechanical weir was not a perfect solution. Some valuable fish were killed. But with the lamprey, there was no time for perfection. The creature was running amuck and had to be stopped. It was necessary to go into battle with the weapons at hand. The electromechanical weir was thrown into the struggle to save the trout of Lake Superior.

The first operational weirs were built in 1953 on streams in the eastern end of Lake Superior, where the lamprey had established a foothold. The weirs were extended in 1954 to cover every suitable lamprey spawning stream on the American side of the lake, and Canada began weiring the northern side. There are 72 weirs on the lake now, 44 on the American side and 28 in Canadian waters.

While finishing up the weirs on Superior, the Americans swung into the task of weiring Lake Michigan's streams. Seven were built along the northern shore of Green Bay last year; others will be installed in lamprey spawning streams throughout the Lake Michigan and Lake Huron watersheds as soon as possible.

The lamprey's plunging attack against the trout and other Great Lakes fishes did not recognize state and international lines. It crossed the American-Canadian boundary, involving the Canadian province of Ontario and eight American states. Each of the affected governments contributed to the fight, but there was no central directing agency. After years of negotiations, a formal treaty to coordinate the battle against the lamprey was worked out by the American and Canadian governments.

The treaty, called the Great Lakes Fisheries Convention, had to be ratified by the U. S. Senate and Canadian Parliament to become effective. Thus it was that earlier this year the deadly little vampire was hauled before the Senate Foreign Relations Committee to answer for his misdeeds. There, in subcommittee hearings last April, the lamprey's blitzkrieg in the Great Lakes was deliberated under the international principles applied to other historic invasions and aggressions. For a while, at least, the lamprey pushed the Kremlin and the cold war out of the picture.

Under the treaty, the counterattack against the lamprey will be directed through an international commission. In effect, it is a mutual defense pact against an active and hostile aggressor.

The main weapon in this counterattack will be the electromechanical weir. But there is one catch. Larval lampreys spend from four to six years in a quiescent stage in the mud of the spawning streams. Each year, adults from one maturing generation emerge from their burrows, drift into the big lake, and begin parasitic life. During their 18 months of adult life, they grow to an average length of 17 inches and kill between 20 and 40 pounds of fish apiece.

Five thousand compounds are being
eened in efforts to find a poison that
ll kill lamprey larvae without harm-
g the desirable fish. Six have shown
omise and will be tested further.

Staggered Generations

The weirs, therefore, will not become completely effective until after their seventh year of operation. For six years after they are installed, succeeding generations of lampreys will enter the big lakes to prey on trout and other fishes.

This, then, is why the two dead lamprey larvae in the glass jar created such excitement in the laboratory at Hammond Bay. The dead larvae represented an extension of the poison experiments started in 1951. The early experiments produced no satisfactory results. Fish and Wildlife Service biologists decided a greater effort was needed, so late in 1953 they collected nearly 5,000 samples of organic chemical compounds. Some were so new they had no names, only numbers. Some were violently explosive at ordinary room temperatures. All were complex in their make-up.

Applegate and his assistants set up facilities for 50 experiments a day. Each compound was tested at a concentration of five parts per million on two lamprey larvae, two rainbow trout fingerlings, and two bluegill fingerlings. Each test lasted 24 hours at a water temperature of 55 degrees F.

After 4,500 tests, 6 chemicals showed, in varying degree, greater toxicity to lamprey larvae than to other fishes. When the first of the six showed up, Applegate started work on the two reinforced concrete raceways that appear in the lawn outside the laboratory. These raceways are 30 inches deep, 6 feet wide, and 65 feet long. Promising chemicals will be tested here under simulated stream conditions. Only after exhaustive tests will a larvicide be used in natural streams.

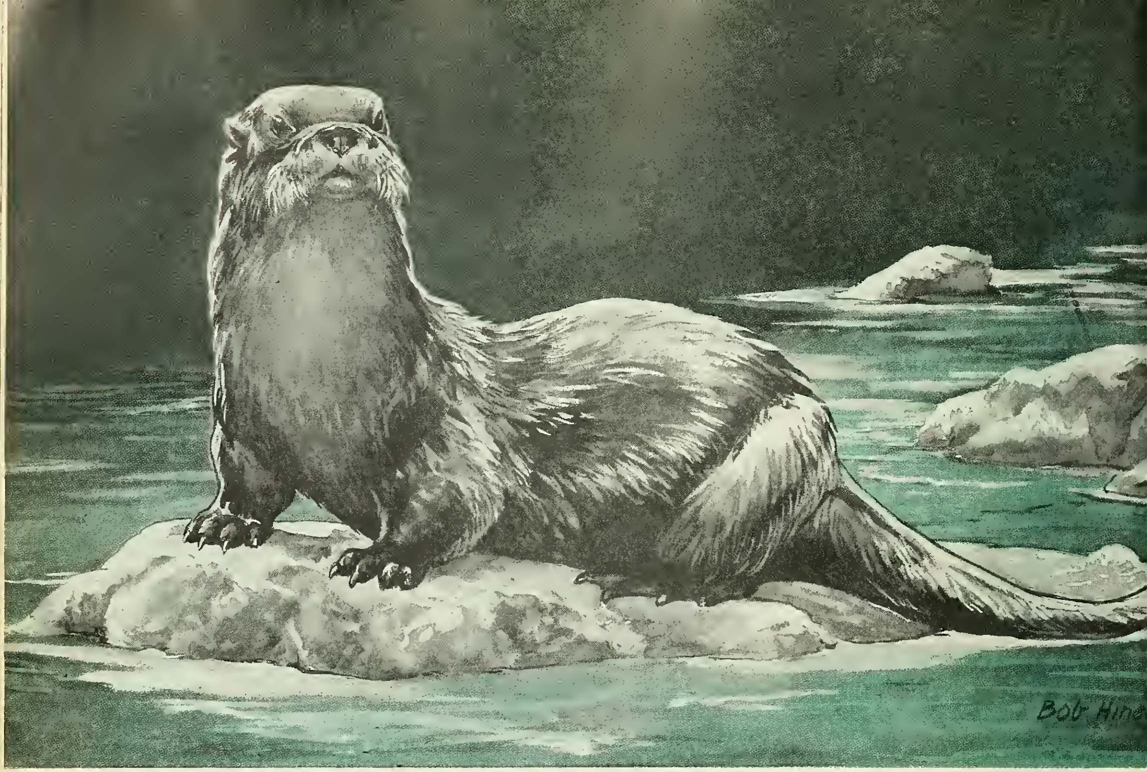
The work is not complete. No practical larvicide exists at this writing. But the prospect is good. Next step in the program is to obtain the services of organic chemists to break down the six promising compounds and isolate the element in their complex structures that appears to be toxic specifically to lamprey larvae.

Applegate believes that the larvicide, when developed, can be applied to the estimated 200 lamprey spawning streams in the upper Great Lakes basin by means of a simple automatic proportioning device, similar to that which puts chlorine in city drinking water. He has estimated that one crew can treat one stream in two days.

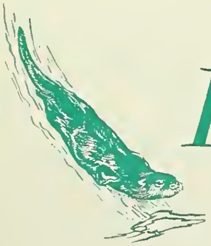
There are still problems ahead. Canada has experimented with a general poison, toxaphene, in three streams of the eastern Lake Superior watershed. Toxaphene is a chlorinated camphene insecticide, heavier than water, effective for about a week after application, unstable in heat and light. Carbon tetrachloride was used as the medium to carry the poison to bottom mud. The usual solution was 10 per cent toxaphene to 90 per cent carbon tetrachloride.

The Canadians reported the poisoning was 80 to 95 per cent effective against the larvae. An estimated 10,000 were killed in one stream and 1,000 in another. But the 5 to 20 per cent survival rate represents a serious threat to complete lamprey control. Although poison treatment of streams may render weirs obsolete at some future date, Applegate feels that the weir program should be pushed vigorously until a poison treatment that is 100 per cent effective is developed.

The prize for success in the chemical experiments could be spectacular – complete destruction of all six generations of lamprey larvae in all spawning streams in one treatment. If this can be accomplished, demise of the lamprey in the upper Great Lakes basin will be even more sudden than that of the lamprey's favorite prey, the trout.



▲ Meet Mr. Otter, known in scientific circles as *Lutra canadensis.* Length: from 40 to 45 inches; weight, about 20 pounds. He is sometimes called River, Land, or Common Otter to distinguish him from his 5-foot maritime cousin, the Sea Otter. Zoologists also refer to him less kindly (but quite accurately) as a large aquatic weasel.



Playboy
OF THE WATERWAYS

It's hard to say where he got the idea. but the otter has found that playing games makes life a lot more interesting

By Will Barker *Illustrations by Bob Hines*

THE boisterous antics of the river otter single it out as one of the most playful mammals of the Western World.

Otter "play" has many variations, but the animals are probably best known for their love of shooting-the-chutes. Both adults and pups participate in this lively game and revel in it with the carefree enthusiasm of sailors on shore leave. Over and over again, they slide down the muddy bank of a stream and "belly-whop" into the water of a deep pool, sending spray flying in all directions.

Otters also rate tag and follow-the-leader as exciting forms of amusement. Entire families play such games, rolling and darting gracefully through the water like so many small dolphins. For solitary fun, one of the animals will occasionally toss a stone into the water and dive in to retrieve it.

During the winter, when a thick blanket of snow covers the ground, otters often cavort about like frolicsome children, diving into the drifts, tunneling through them, and and "surfacing" just as though the snow were water.

Besides their love of group sports, otters display an engaging affection for others of their kind. This was demonstrated by a pair that Bob Hines, creator of these drawings, observed swimming along a watercourse in Mattamuskeet National Wildlife Refuge in North Carolina. Every so often these two would rear up out of the water and rub noses—like the Eskimos. Hines was lucky to see such a demonstration, because otters are extremely shy and secretive near the haunts of men.

River otters are scattered thinly over most of the United States, excluding the deserts of western Texas, southeastern New Mexico. southern California, Nevada, and Utah. They also occur in Canada, and in Alaska except on the treeless tundra of the Arctic slope.

As you would expect, these graceful, agile swimmers get most of their food from their watery environment. They like fish but do not eat as many as some critics have supposed. Their principal and favorite food seems to be crayfish, with random side-orders of frogs, snakes, turtles, mussels, snails, insects, worms, and succulent water plants.*

The otter is a powerful fighter for its size and is usually more than a match for an aggressive dog, either on land or in the water.

Vocal efforts include nasal snufflings and, when the animal is aroused, growls and snarls. Some observers credit otters with birdlike chirps and shrill, piercing whistles.

Although there are a number of geographical variations, the home life of all otters is much the same. The den is usually at the end of a burrow in a bank, and often has its entrance below the surface of the water. Sometimes the animals occupy the base of a hollow tree; and in the flat marshes and tules of California, otters bend together tall marsh plants to make a small, circular enclosure. One to five pups are born in April and stay with their mother until almost a year old.

If you are fortunate enough to obtain one of these sleek, sinuous, web-footed creatures, you will find that it makes a delightfully gentle and affectionate pet.

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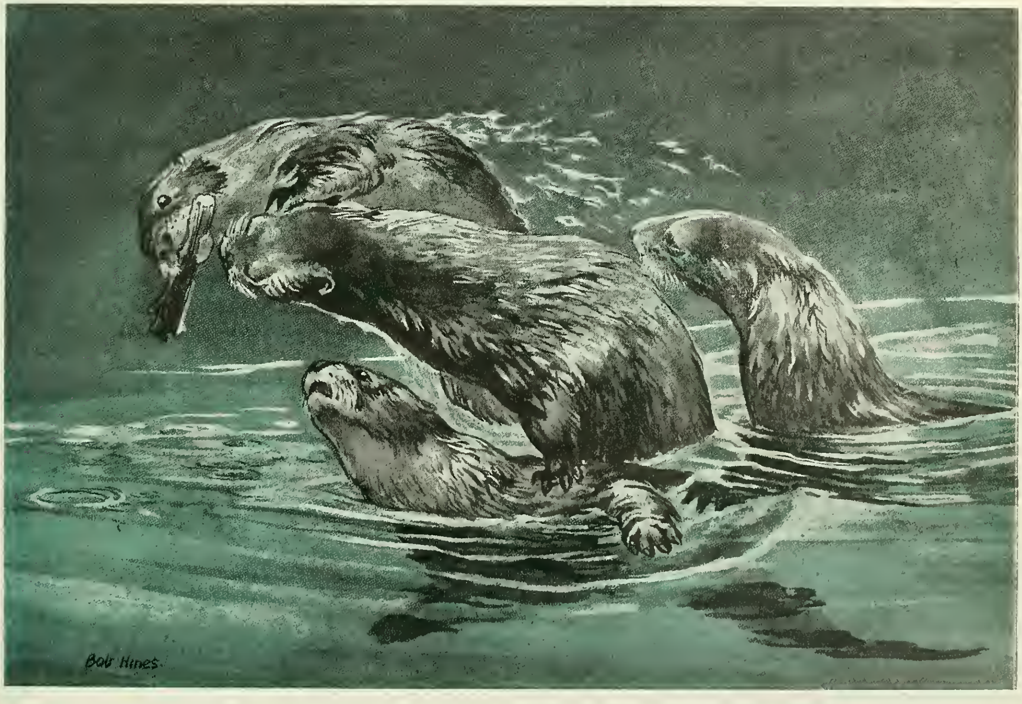
*See "My Friends the Land Otters," by Emil Liers, NATURAL HISTORY, September, 1951.



▲ **Otter pups at play.** Young otters, like young seals, must be coaxed into the water by their mothers, but they soon learn to swim and dive with almost effortless speed and grace.

UNITED STATES
Palmar
COSTA RICA
SOUTH AMERICA

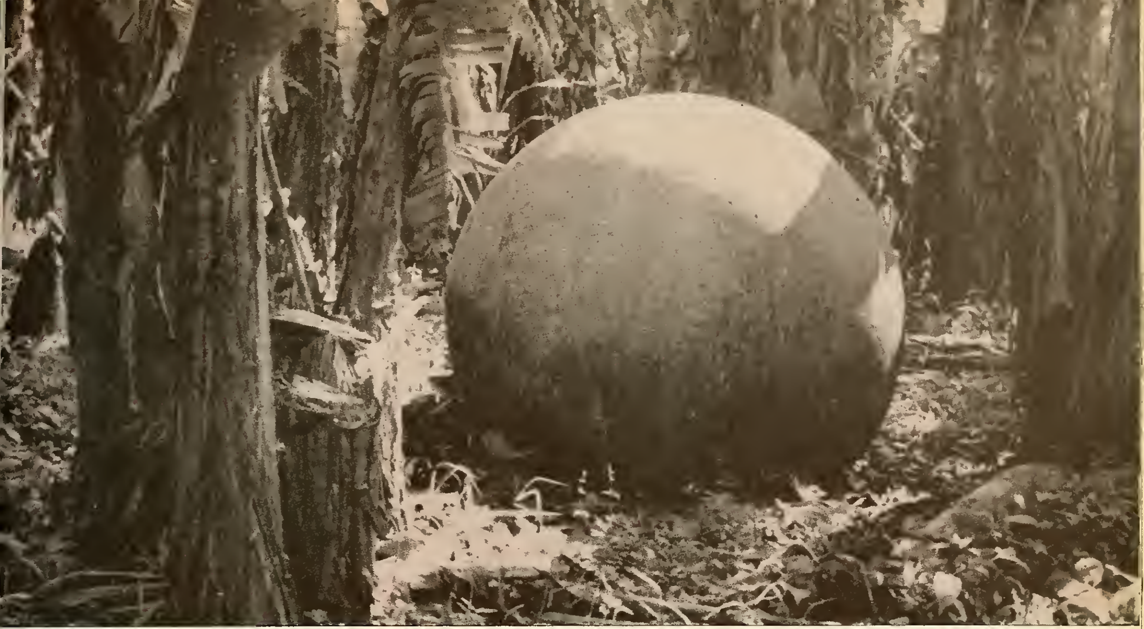
Mystery of the Prehistoric Stone Balls

Hundreds of them dot the jungles of Costa Rica, as baffling as the monuments of Stonehenge. How were they made, and why?

By
ELEANOR LOTHROP

Photographs by the author and Paul Allen

◀ THE AUTHOR ar her husband restin by one of the sphere But for a revolutio they might never ha investigated the



▲ SOME of the balls are more than six feet in diameter, and were moved many miles over hill and dale from the nearest source of stone. Some were even found on mountains.

AS THE unscientific wife of a scientist, who for years has tagged along on archaeological expeditions, I have witnessed many seemingly unexplainable discoveries, but none has provided a greater challenge or teased my imagination more acutely than the unbelievable stone balls found in Central America. The riddles they pose would threaten the deductive powers of a Sherlock Holmes.

Why should hundreds of these perfectly shaped spheres, ranging in diameter from a few inches to eight feet, be scattered through the jungles of southwestern Costa Rica? How could prehistoric people have shaped them with only the crudest of tools? And how could they have moved them over hill and dale from the distant sources of stone? No other stone balls of like size have been found anywhere else in the world, except for a few in the highlands of Guatemala and in Vera Cruz. The smooth, beautiful, and almost perfectly rounded spheres give mute testimony to the artistic powers of an ancient people and tax modern man's ingenuity in explaining their workmanship and significance.

My acquaintance with them came about by pure chance.

A few years ago, my husband and I had made plans to spend the winter digging in a small Costa Rican town called Filadelfia, near the Nicaraguan border, where we had begun work the winter before. We reached Costa Rica prepared for any emergency, or so we thought, but we had overlooked the possibility of a revolution. There had been shooting and a few murders near the Nicaraguan frontier, bandits were taking advantage of the situation to loot the countryside, and Filadelfia might well be on their route. We wanted to keep to our plan, but the Lothrops were not thought to be worth a possible international incident, and Filadelfia was declared definitely out of bounds.

Two weeks after our arrival in Costa Rica, we were comfortably ensconced in the house of friends in San José, with no apparent prospect of getting any further. Neither Sam nor I was happy. We were feeling especially desperate one day when our hostess came forth with the magic word "Palmar."

"Palmar? What's that?" asked Sam.

"A banana plantation on the Panamanian border," she answered.

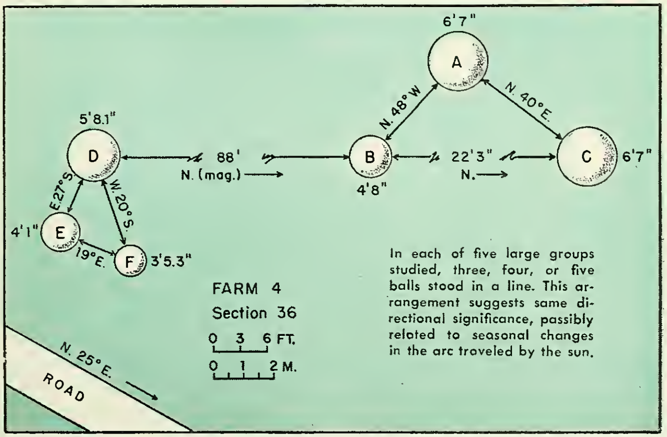
"And what do you find there besides bananas?" asked Sam, without much enthusiasm.

"Well," said our hostess, "there may be ancient burials, although I'm not entirely sure. But there are some very strange stone balls—obviously prehistoric, though no one knows what they represent or where they come from."

"No one knows?" said Sam. His eyes lit up, and his face took on the look of a bloodhound about to be let loose on the scent. After all, the work of an archaeologist and a detective is basically the same, with the small difference that a detective gets much better pay.

"Let's go to Palmar," said Sam. At Palmar, we found that the United Fruit Company had built an elaborate settlement for their employees in the midst of a steaming jungle some twelve miles from

▲ Whatever their original purpose, these round balls now decorate the lawn of a banana plantation manager, who had them placed there for ornamental effect.



In each of five large groups studied, three, four, or five balls stood in a line. This arrangement suggests same directional significance, possibly related to seasonal changes in the arc traveled by the sun.

▼ Almost all of them were carved from the local lava. Nothing has been found of any of the tools or instruments that were used in making them.

the Pacific coast. We were allotted the comfortable house of a vacationing employee and were soon looking for the stone balls. We didn't have far to go. Next door was the house of the company manager, and beyond it a public park. In the exact center of the park was a perfectly rounded sphere about three feet in diameter.

"Sam, we've found it," I cried, feeling like Archimedes, or perhaps Mrs. Archimedes.

"*It!*" exclaimed the company manager. "Why, there are lots of them. Are you interested?"

We admitted we were very much interested, and the company manager straightway took us on an inspection tour. We crisscrossed thousands of acres under cultivation, and the countryside fairly teemed with stone balls. The company manager seemed to know each one personally and stopped the car six or seven times for us to get out and take notes. A few days later we started work in earnest.

In two months we examined 60-odd balls in their original locations, some underground where they had been covered with silt from overflowing rivers. There must have been hundreds or even thousands we didn't see. There were also great chunks of rock, the remains of balls that superstitious natives had blasted to bits in the belief that they might contain gold.

The balls were almost all carved from the local lava, and they varied in size and workmanship. Even the poorer ones, however, were extraordinarily well made, and our measurements showed that the ones that had apparently been shaped by the Epstein of that time were nearly perfect spheres.

On the morning we started work, I was surprised to see that Sam's equipment consisted of a tape measure and a fishing line with a lead sinker hanging from the end of it.

"Where's your hook?" I asked, wondering if he had decided to have a day's fishing on the near-by river.

He gave me a long-suffering look.

➤ EXCAVATIONS to ascertain age were made where river silt had buried balls near other artifacts.

▼ A STONE ANIMAL that was carved by the same people.

"This is a plumb bob," he explained. "It is attached to what is called a plumb line." He spoke slowly and clearly as if to a child. "As the bottom of many of the big balls are underground, and it would take too long to dig them out, we will use the plumb bob to measure their diameters to find out if the balls are perfectly round. See?"

"Of course," I said at once, although I didn't see at all.

I still don't see, although for many days I watched Sam performing incredible gyrations with plumb line dangling from one hand and tape measure clutched in the other, while I ran around blindly jotting down figures.

The first site we tackled contained three enormous stone balls, and after several hours of mysterious computations, Sam pronounced all three to be six feet in diameter and practically perfect spheres.

"Good," I said with relief, as the temperature had reached 94 degrees and my head ached. "Let's go home and have a cold drink."

"Not at all," said Sam. "As long as the diameters don't show any variation, we'd better take the circumferences."

"Why?" I asked, which is the word I use most frequently on archaeological trips.

Sam sighed. "Because anything that is six feet in diameter must be almost twenty feet in circumference, and errors will therefore be more easily detected."

This time I swallowed the "why" because I recognized that no explanation would make a mathematician of me. So we enlisted the aid of two workmen to help hold the tape.

Even so, it was a difficult job. We took five circumferences on each of the first two balls. Sometimes I would climb on top of the sphere, sometimes lie on the ground, and occasionally I tried to stand on my head. When the measurements all turned out to vary less than an inch, I decided we had done an awful lot of work for nothing; but Sam seemed pleased. And Armando, one of our workmen, a youth of 22 who was wildly enthusiastic about everything American, said "Okay." He had mastered two other English phrases: "What's cooking?" and "Nuts to you," neither of which he understood.

It was hard to believe that the stone balls could have been manufactured without some mechanical aid, but no instruments of any kind were found to give us a clue. If the conquering Spaniards ever witnessed the process, which seems unlikely, they made no record of it. As there were no stone quarries in the neighborhood, we asked Armando, who had a life-long knowledge of the surrounding country, whether he had ever seen one.

"Never," he answered. "There are none anywhere near here."

"You're sure?" Sam insisted.

"Sure," said Armando, and added, "Nuts to you."

This time, by pure chance, he had picked the right phrase.

Others we asked agreed that there were no quarries within miles, and we ourselves conducted a fruitless search. The balls must therefore have been manufactured at some remote spot, as the rough blocks could never have been moved any distance. The largest ones must have weighed a great many tons.

It is hard enough to imagine how the Indians managed to roll the finished spheres through overgrown jungle and to the tops of adjacent mountains, where some of them have been found.

"In fact, it's impossible," I said to Sam. "I believe they are some sort of cosmic phenomenon like meteors. Maybe they dropped from the sky."

"If so, it's lucky they didn't hit anyone," said Sam without a smile.

"But seriously," I insisted, "even Man Mountain Dean couldn't have transported one of these enormous things on dry land. And as for crossing the rivers. . . ."

Sam interrupted my eloquence and put me in my scientific place. "The Indians undoubtedly built rafts for carrying them over the rivers in the rainy season when the water was deep."

"But why was it so important to get them here?" I asked. "And why did the Indians bother to make them? It must have taken a man a lifetime just to turn out one, and what could he do with it when it was finished?"

And so, not having done very well with our first problem, we found ourselves up against our second.

The stone balls were obviously of great importance to the people who made them, though they could have had no practical purpose. I spent my time trying to think of every possible use to which they might have been put, even entertaining the notion of games for the kiddies or bowling contests. Some did weigh only a couple of pounds, but most of them would have required an army of men just to set them in place.

"I have come to the conclusion," I finally pontificated, "that the balls had no useful purpose." Which of course Sam had known all along.

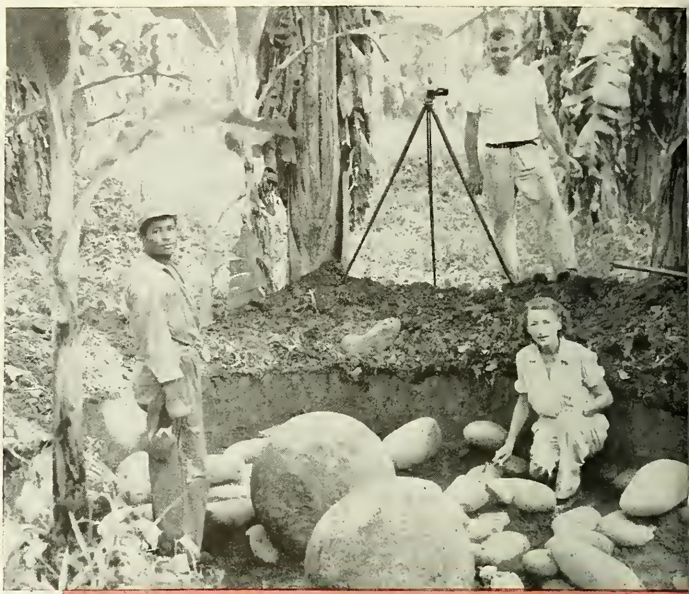
"Could they have been for decoration?" I asked.

Sam shook his head. "They must have had religious significance," he said. "Their position bears out that theory."

"Position?" I asked, completely confused. "How?"

"We've examined five large groups," he explained, "of which at least three appear to be in their original positions. In each case, there was a base line of three, four, or five balls. All these groups had additional balls flanking the main line in such a fashion that three of them formed a triangle. By arranging them this way, various lines of sight were created, which may be of astronomical and ritualistic importance."

"Why?" I asked.



▲ The Lothrops found stone balls in one of the first places they dug. These two had been silted over among boulders.

Sam gave me a look of patient forbearance. "Because these lines of sight may very well have had some relationship to the sun, thus showing seasonal changes and helping the people to know the right time of year to plant their crops. In certain regions of the Maya area the Indians built structures for this purpose. Some of the Maya stelae, for example, are linked to astronomy. And here the same result was probably obtained by means of the stone balls."

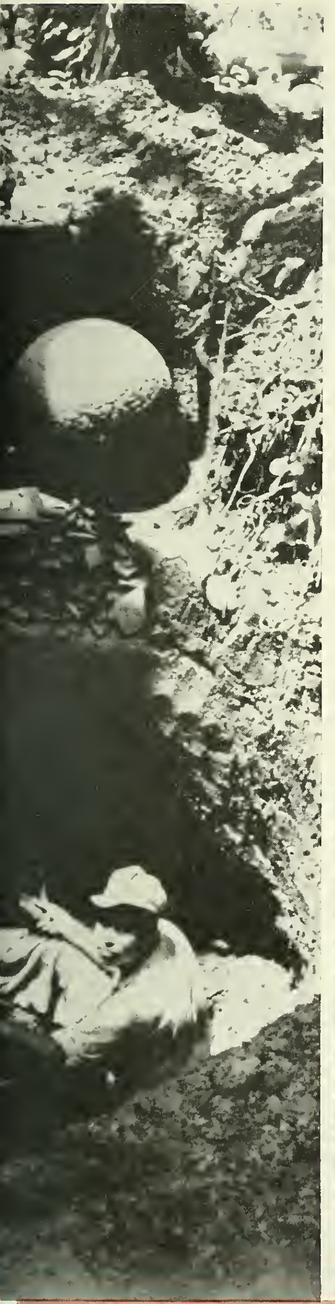
"But that's a practical purpose," I protested. "Not religious."

"Astronomy and religion were closely associated with the practical pursuits of life such as agriculture," Sam said.

I nodded and tried to look intelligent. It was obvious even to me that the stone balls must have a religious significance, if for no other reason than that it was the only explanation for them.

The third question—*when* the balls were made—was the only one for which we found a definite, if only partial, answer. Sam had decided to devote the rest of our stay in Palmar to digging for other evidence of the people who made the balls. This delighted me, because a dig is very much like a treasure hunt; and it delighted the workmen even more, who were certan we would find gold. It seems that three years previously a large piece of ground was being prepared for cultivation when a Costa Rican who was driving a bulldozer noticed a glitter in the earth. Jumping out of his machine, he clawed excitedly at the ground until he extracted a pot filled with gold ornaments. He promptly removed his helmet, stuffed it with treasure and disappeared, leaving the engine of the bulldozer running.

He sold six of the pieces in Palmar for about $240; the rest he took to San José where, according to local gossip, he disposed of them for $7,000, living for one year in the capital in great style on the proceeds. He was now back at his old job penniless after his big fling.



This story had fired the imaginations of all the other Company laborers, and the spot had been pulled to pieces, although nothing more had turned up. The Fruit Company had finally been forced to decree that digging without special permission was illegal.

We found no gold, but we did find two stone balls in one of the first pits we sank. They were not far below the surface, and we dug them out in order to see if there was anything underneath. The balls were resting on stone platforms, so we knew they were in their original positions.

When pottery turned up below the area where the platforms had been placed, Sam's expression resembled that of a man who had found the equivalent of the Kohinoor diamond. The pottery was interesting, and I was pleased too, but Sam's enthusiasm seemed excessive.

"It may give us an idea how old the balls are," he explained.

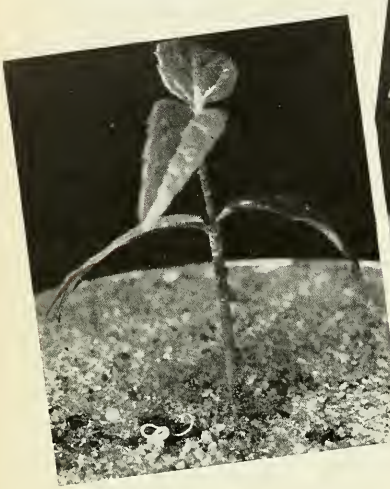
Sam's optimism was justified. Some of the pottery under one of the stone platforms turned out to be of classical Chiriqui type, best known in western Panama. We already knew from other evidence that this pottery was still being made at the time of the Spanish Conquest. Thus, by the same token, the stone ball found above it must also have been made at approximately the same period. The majority of the stone balls were probably considerably older, but it is safe to say that, although their date of origin is open to speculation, the cult of making stone balls was a late one, continuing into the sixteenth century.

Some day more information may be procured, but meanwhile the balls remain as enigmatical as the huge statues on Easter Island or the monuments of Stonehenge. In each of these places, enormous stones have been quarried, shaped, and moved without mechanical devices except ropes for hauling them and inclined ramps for lifting them.

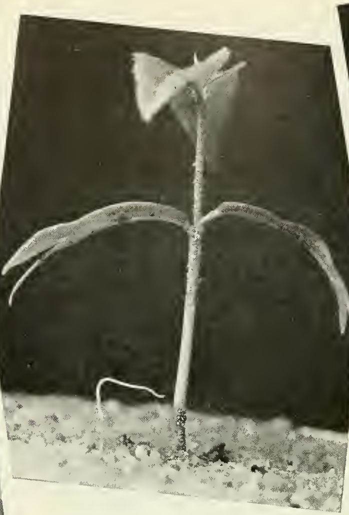
Maybe our own civilization contains elements of material culture that will survive all knowledge of their purpose. So it goes: one era's triumph is the next era's riddle.

▲ SOME of the balls, like the one shown here, rested on stone platforms, showing they were in their original positions.

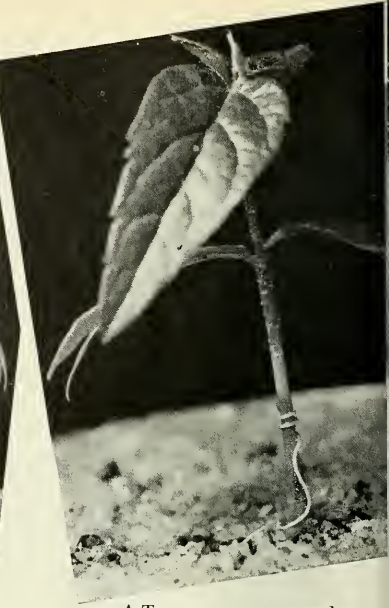
▲ DR. LOTHROP removing pottery from the same cultural horizon as the stone balls. Investigations proved that they were made around the time of the Spanish Conquest or earlier. No written records of them exist.



▼ When the dodder seed sprouts (bottom of picture), it sends out a tendril-like stem. The plant has lost a true root system with the development of a parasitic life. It lives on nourishment within the seed until it can find a victim.



▲ About twelve hours after the preceding photograph, the stem has extended upward and is "seeking" a suitable host.



▲ Twenty-four hours later, the dodder has twined itself about the host.

Dodder—A Vampire Plant

It lives at the expense of others and is able to spread diseases among plants

By Ross E. Hutchins
Entomologist, State Board of Mississippi

All photographs by the author except as otherwise credited

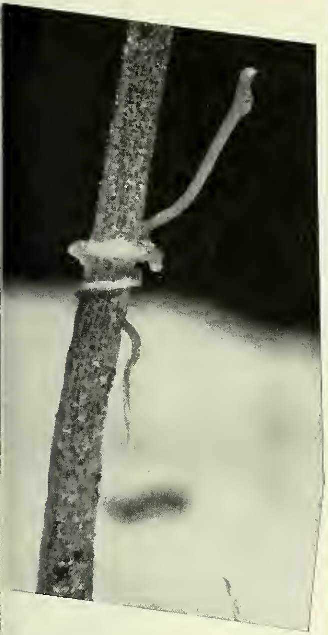
Many people do not realize that there are parasitic plants just as there are parasitic animals. Yet many plants depend upon a "host" and draw their nourishment from its tissues just as surely as a flea does from a dog's.

Probably the commonest parasitic plant is the mistletoe. Its various species embrace an almost worldwide distribution, and it has figured in the superstitions and legends of almost every land. Actually, mistletoe is not a complete parasite. It possesses abundant chlorophyll and with the aid of sunlight is able to manufacture most of the necessary growth materials in the normal way.

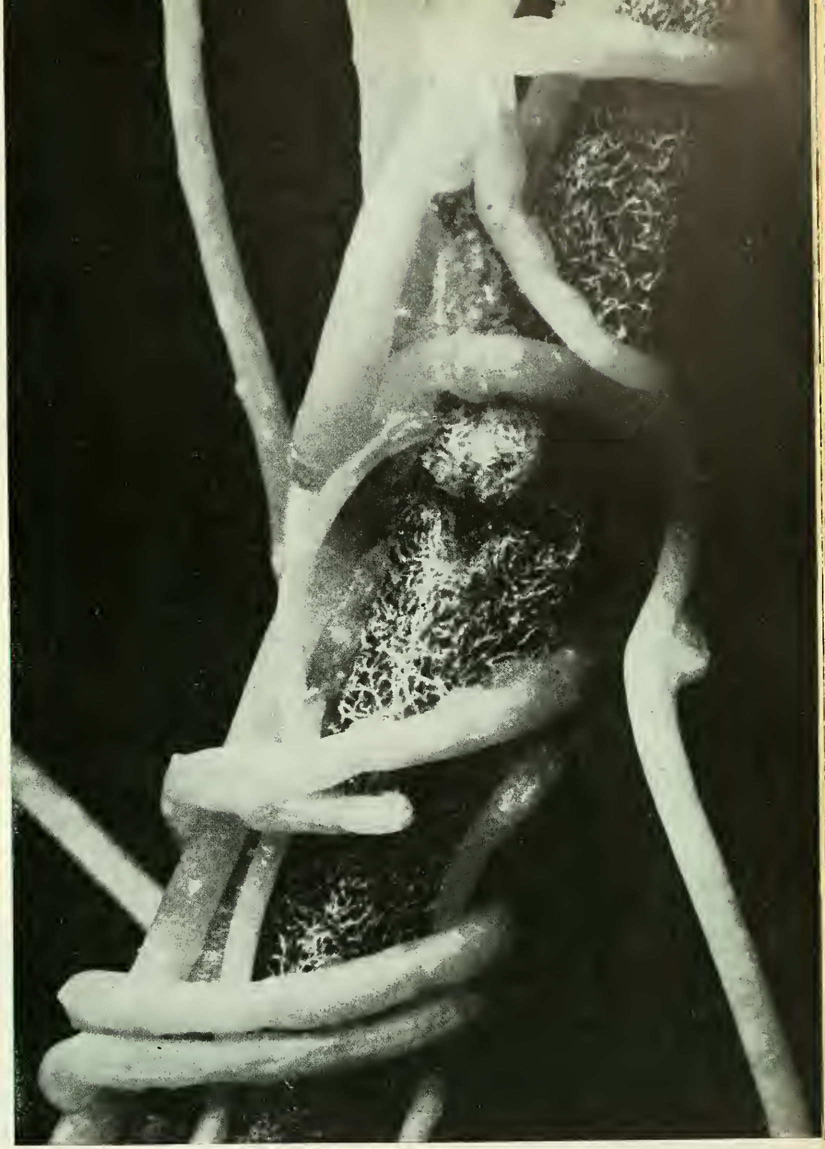
Another group of plants that deserve attention among the "spongers" of the plant world are the dodders. Some say they are total parasites, lacking chlorophyll, but it has also been claimed that they may have enough chlorophyll to sustain themselves. Other names under which the dodders are known are love vine, strangleweed, goldthread, and hell-bind.

Dodders begin life as seeds that drop from the mature plants in late summer or autumn. The next year, under proper conditions of warmth and moisture, the seeds germinate. But they generally wait until about a month after other plants; otherwise they would have difficulty finding a host! If conditions are not favorable the first summer, they can survive and sprout as much as five years later.

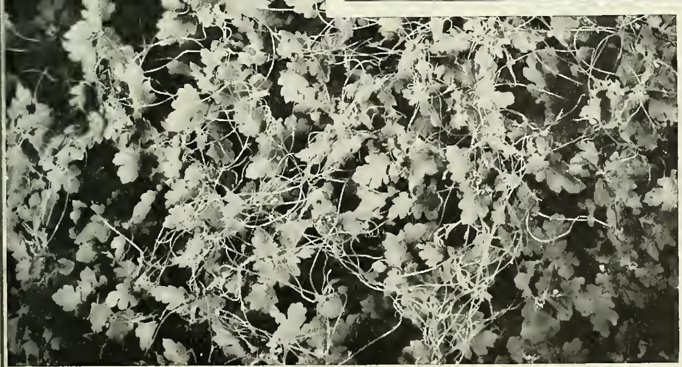
Unlike most seeds, the dodder seed does not produce any true root system but only an abortive root, which attaches the plant to the ground and absorbs water during the period of free existence. The seed then gives out a slender stem,



ANOTHER WEEK and the parasite as developed highly modified ›ots that attach it firmly to the ost. It has broken its attach-ıent with the seed and is now ılly launched on its parasitic ıreer. Near the growing tip, it as also produced the first ves-gial leaf.



▲ THIS CLOSE-UP of a dodder on a chrysanthemum plant shows how the parasite has grasped the host in its coils. The roots by which it draws nourishment can be seen.



◄ BY LATE SUMMER, the host plant is often covered with this conglomeration of silken tendrils, which steal its nourishment and cause stunting and loss of vigor.

which pushes upward and is ready to twine itself about any luckless plant that may be growing within reach. If no host is present, the dodder may lie quiescent for several weeks without apparent growth. Or it may run along the surface of the earth, if no plant is growing close, drying at one end and growing at the other for as much as several inches before it perishes or finds a suitable host.

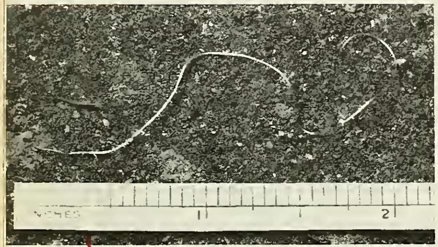
Shortly after twining about its host, the young dodder begins to develop "adventitious" roots, highly modified for absorption. These attach themselves to the host and in time connect with its conductive cells for the absorption of nourishment. As soon as this attachment is established, the young dodder is fully launched on its parasitic career, and the stem extending down to the original seed shrivels and is broken. The plant must now live at the expense of its host. It draws its nourishment from the host through direct connections, as can easily be proved by placing a plant covered with dodder in a glass containing red coloring of the sort used in cake icing. The dodder will show the red color as soon as the stem of the host plant does.

As the young dodder grows, it begins to extend branches in various directions. These in turn twine about other parts of the same plant or about other plants growing within reach of its tendril-like stems. This latter habit has caused some concern among scientists who specialize in plant diseases, for it has been proved experimentally that dodders can thus transmit certain virus diseases from plant to plant.

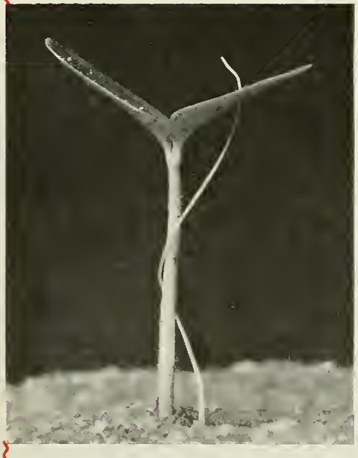
As the season progresses, the dodder becomes a mass of silk-like threads, which nearly smother the host plants upon which they live. Soon clusters of tiny, whitish blossoms are produced. In time, each results in a round seed pod containing from one to four seeds. These, of course, eventually fall to the ground, and when spring comes again, the cycle starts over.

There are 120 species in the dodder genus, *Cuscuta*. They are found almost everywhere within the temperate and tropical zones. In general, they appear to parasitize a wide variety of hosts, but most authorities agree that they attack some plants more readily than others. In some areas of the United States and Europe they are major crop pests, causing considerable damage to clovers and other leguminous plants. In such cases, chemical and other means of control have been found necessary.

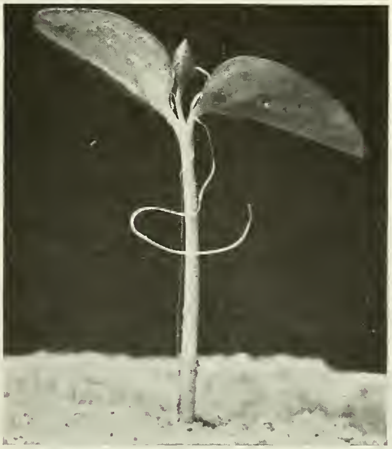
Not much is known from direct evidence about the past history of these interesting plants, for they have apparently left no fossil remains. But we can say with fair certainty that they evolved from simple chlorophyllous climbing morning-glories that found they could get food more easily by sinking their holdfasts into the flesh of the living supports.



▲ THE DODDER can extend its infant stem for 3 or 4 inches. It can also run several inches along the ground, drying at one end and growing at the other, if it does not find a suitable host near by. This photograph was taken about 10 days after sprouting.



▲ IT MIGHT SEEM that this seedling dodder has found a succulent host plant to parasitize. But notice what happens in the next picture, taken a few days later!



▲ THE PROSPECTIVE HOST apparently was found repellent. The original stem of the parasite has shriveled, but after climbing about the plant, the dodder has finally begun to move away, still seeking a host.

▲ WHEN THIS SMALL WOODEN P
was placed near a sprouting dod
seed, the parasite attempted to
tach itself. Failing to find nour
ment, it tried farther up.

▲ As the season advances, these tiny blooms appear amid the tangled mass of dodder.

➤ Finally, the dodder puts forth clusters of small, whitish blossoms.

▲ Each spherical seed pod produces from 1 to 4 seeds, which may remain viable for as long as 5 years.

he following summer, this may result. The normal nts may seem to get a headstart on the dodder, but the lder bides its time, and after its future food supply has ched satisfactory proportions, takes over. Its tendrils e completely enmeshed the desert shrubs shown below.

Henricks Hodge

▲ Even the dodder has its enemies. This one is afflicted with aphids, at least two species of which feed on dodders. A parasite on a parasite. Who knows, maybe the aphids are also vicitmized.

Don't call me Doctor!

When asked to take the place of the medicine man, the explorer may suspect that his own life is as much in danger as the patient's

By

Harry Tschopik, Jr.

▲ Gustavo (foreground) was sour and sharp-tongued while serving the author as river pilot.

When two persons misjudge each other, their relationships are apt to be strained. When one of the two happens to be a semi-wild jungle Indian—with only a superficial knowledge of the white man's civilization—the situation may become serious.

I had classified Gustavo as just another in an ever-changing series of river pilots, and he had placed me in an equally ill-fitting pigeonhole. Our misconceptions were to give me some anxious moments later.

I watched him as he maneuvered the small motor launch through the muddy cross-currents of the Ucayali, preparatory to making a landing at the Peruvian river port of Iparía. He sat hunched over the wheel, his broad feet cramped under him on the bilge boards between a stem of green plantains and a box of salt fish. Sweat, trickling down the muscular ridges of his back, wet his patched and faded dungarees. On the back of his head

was plastered a battered army cap, below which gleamed nine long scars, each the token of an outraged husband and an illicit love affair.

He cast a swift glance over his shoulder to gauge the direction of the current where the Río Iparía entered the Ucayali from the left bank. In the septum of his nose he wore a disc of hammered silver, and his glossy blue-black bangs hung to eye level in the customary style of the Conibo Indians. Traces of indelible paint, applied some weeks earlier, were still visible on his high cheek bones.

His somber dark eyes darted quickly to the right, estimating the distance from the jungle wall, which here trailed its cascade of vegetation over red clay banks. In profile his forehead, having been artificially deformed in infancy, slanted straight back from his nose, and deep lines bracketed a bitter, discontented mouth.

"Wake up and start sounding, you lazy Piro," he bawled at Oscar, who stood poised on the bow, pole ready in hand.

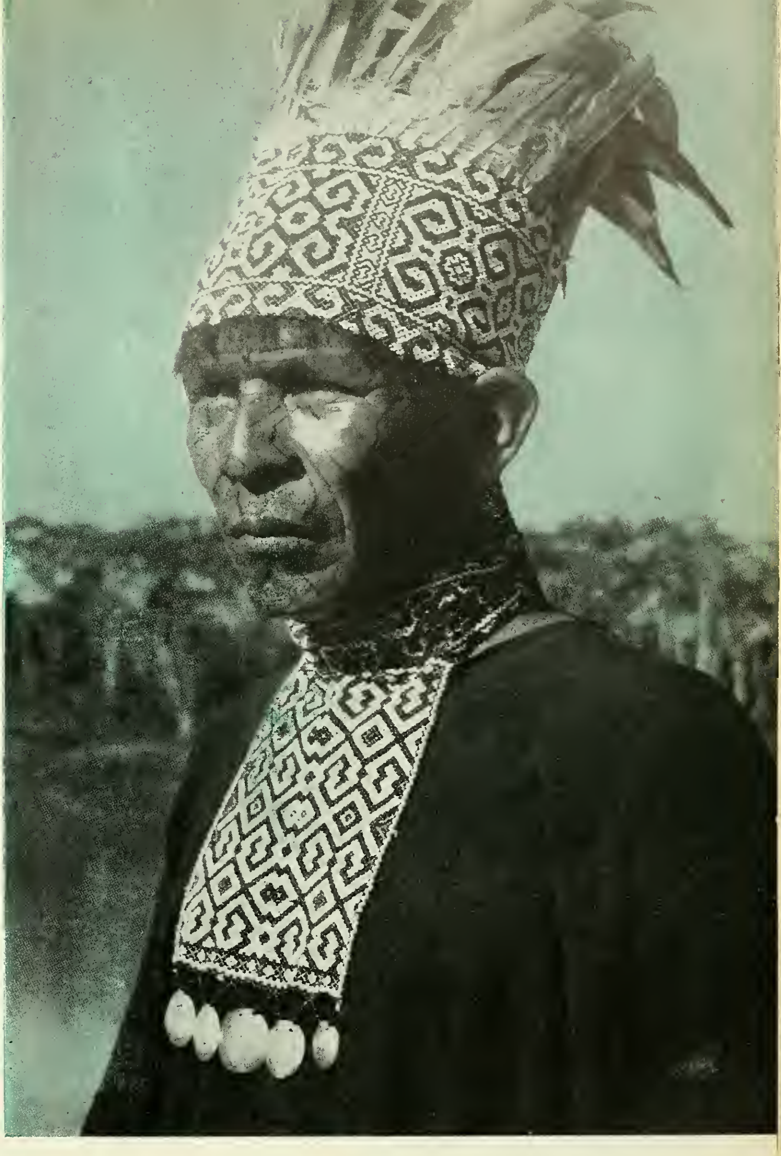
The launch curved in a carefully calculated arc, avoiding the slow spinning eddies of a whirlpool, and headed for the far shore. Sullen or no, Gustavo was a thoroughly competent pilot, which was why he had been engaged by the expedition to navigate the ever-changing channels of the Upper Ucayali and its tributaries.

At Iparía, the rain forest of the east Andean slopes spreads luxuriantly over gently rolling hills that descend in abrupt bluffs to the river. Here the Ucayali, describing a great brown curve, flows northward to the Amazon, hundreds of miles away downstream. Across the river, flat jungle extends in an endless sea eastward into Brazil.

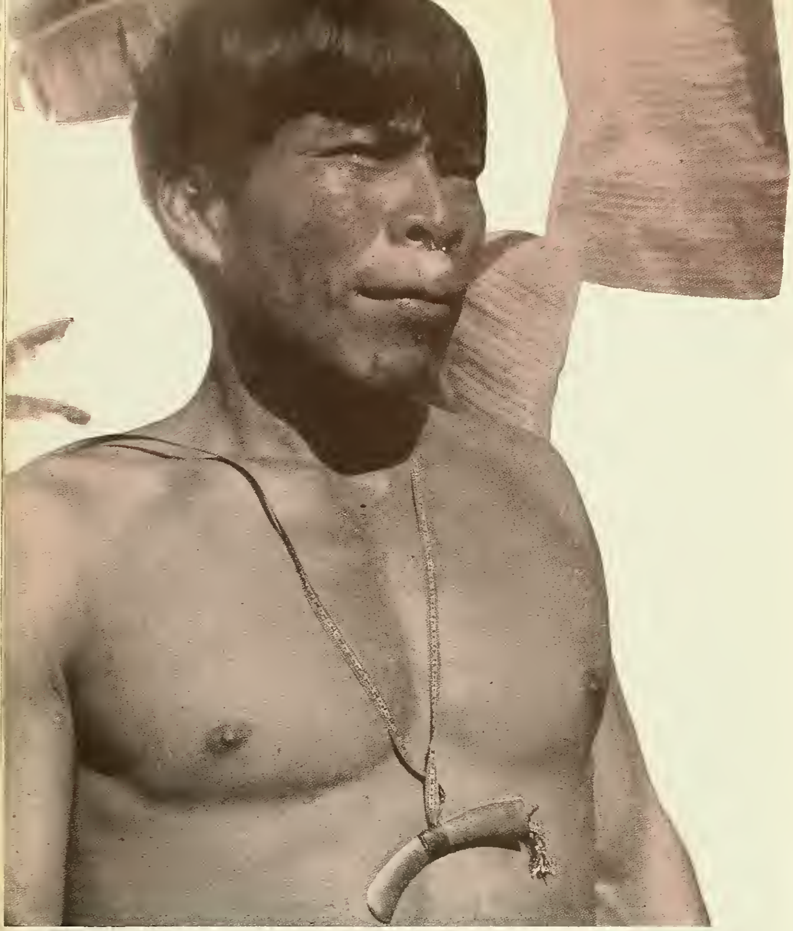
The town came into view between immense trees—two rows of thatched houses ranged down the length of a jungle clearing. Zebu cattle grazed in a meadow and browsed in the deep shade of an ancient mango. Spikes of scarlet *tangarana* and the huge umbrellas of *lupuna* trees accented the forest backdrop. Numerous dugout canoes and two decrepit launches were moored at the bottom of the path down the cliff, where women of the town washed clothes and drew water. Pigs rooted at the river's edge, and naked children splashed in the scorching afternoon sun.

Santiago, our mestizo mechanic, cut the motor while Gustavo nosed the launch in between a large dugout and a battered hulk whimsically christened *Noche de Amor.* Jonás, another Piro Indian who, when not asleep, was our man-of-all-work, waked from his nap on top of a gasoline drum just in time to jump ashore with a line.

This was the first town we had seen since our departure a month earlier to film anthropological



▲ In the village, Gustavo shed his dungarees and army cap for his native regalia and ordered the author to save his dying cousin.



▲ THE MEDICINE MAN seemed not altogether satisfied with his civilized competitor's bedside manner.

movies of the Campa Indians upstream.* A month is a long time in a 35-foot launch loaded with cameras. sound equipment, food, ethnological collections, and seven people.

As the townspeople climbed down to greet us, Oscar shouted derisively, "Lock up your women! Sharpen your knives! Here comes Gustavo, and he still has room for another scar!"

Gustavo merely glowered and stared at the water. "Dirty, stinking Piros." He spat into the river and wiped his mouth on his forearm.

"Better put on a new coat of paint, or the girls won't love you," taunted Santiago.

"Cut out the chatter and get ashore," yelled Raúl, who owned the launch. "Oscar, see if there is gasoline. Jonás, buy oranges and lemons. You, Santiago, round up some chickens."

Raúl laid a hand on Gustavo's shoulder, and it was promptly shrugged away. I knew that Raúl was disturbed by the perpetual ribbing Gustavo received from the others. We had discussed it many times. Gustavo had no sense of humor, but he did have a vicious temper.

The crew had gone ashore, and Raúl followed. Gustavo sat hunched over the wheel, brooding. I lit a cigarette and tossed him one, and he came aft for a match.

"It's too hot to go up into town now," I said. "Let's go for a swim." We found clean clothes, borrowed a canoe, and paddled up the bank of the Ucayali to where it was joined by the clean, cool waters of the Río Iparía. The tributary stream flowed shallow over pebbles and white sand. Overhead arched the forest, trailing lianas bright with orange flowers and streamers of air plants.

I wondered at this strange, sullen Indian who appeared to detest Indian, mestizo, and white man alike. In something over a month I had learned almost nothing about him. He had served for two years in the Jungle Division of the Peruvian Army near Iquitos and had there learned a smattering of Spanish. But he clearly preferred his tribal customs and had more than his share of the native arrogance typical of the semi-civilized, semi-wild Conibos. He had nothing but contempt for the casual, indolent Piros who, under strong missionary pressure, had discarded their traditional culture for the white man's ways.

We reached a deep pool where the water swirled around smooth granite boulders, and beached the canoe. Gustavo dove into the pool, swam the length of it several times, and then stood up, pouring out a torrent of invective that was all the more startling because I had never before heard him speak more than a sentence at a time. Shorn of dungarees and army cap, the sun glinting on his nose ornament and wet brown skin, he ceased to be the pilot of a river launch; he was a savage aristocrat.

"Here no one respects me." His eyes flashed, and he shook the water from his bangs impatiently. "Those dirty, shiftless Piros make fun of me, and Santiago—that good-for-nothing *cholo*—dares to joke with me. I am a man of property. I have a great house, groves of plantains. and many pigs. He has nothing. not even a wife."

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*See "Filiming Jungle Fishermen," by Harry Tschopik, Jr., in NATURAL HISTORY for January, 1955. ED.

He clenched his fists and raised his voice: "I have three wives, and eight children, and many grandchildren."

The monologue continued: "Even to don Raúl I am just another Indian." He smiled with his mouth. "I am *not* just any other Indian."

I was impressed and uncomfortable, but he seemed to have run down. I made a mental note to record in my field journal that some Conibos showed paranoid tendencies. We dressed in silence and dragged the canoe back into the stream. I gave him another cigarette.

We paddled downstream without speaking. When the Ucayali was again in sight, he turned suddenly to face me. "You have listened to me, Doctór. When we reach Porvenir, you will visit me. Then you will see what I am. The others will go back to Pucallpa with the launch."

Entree to the Tribe

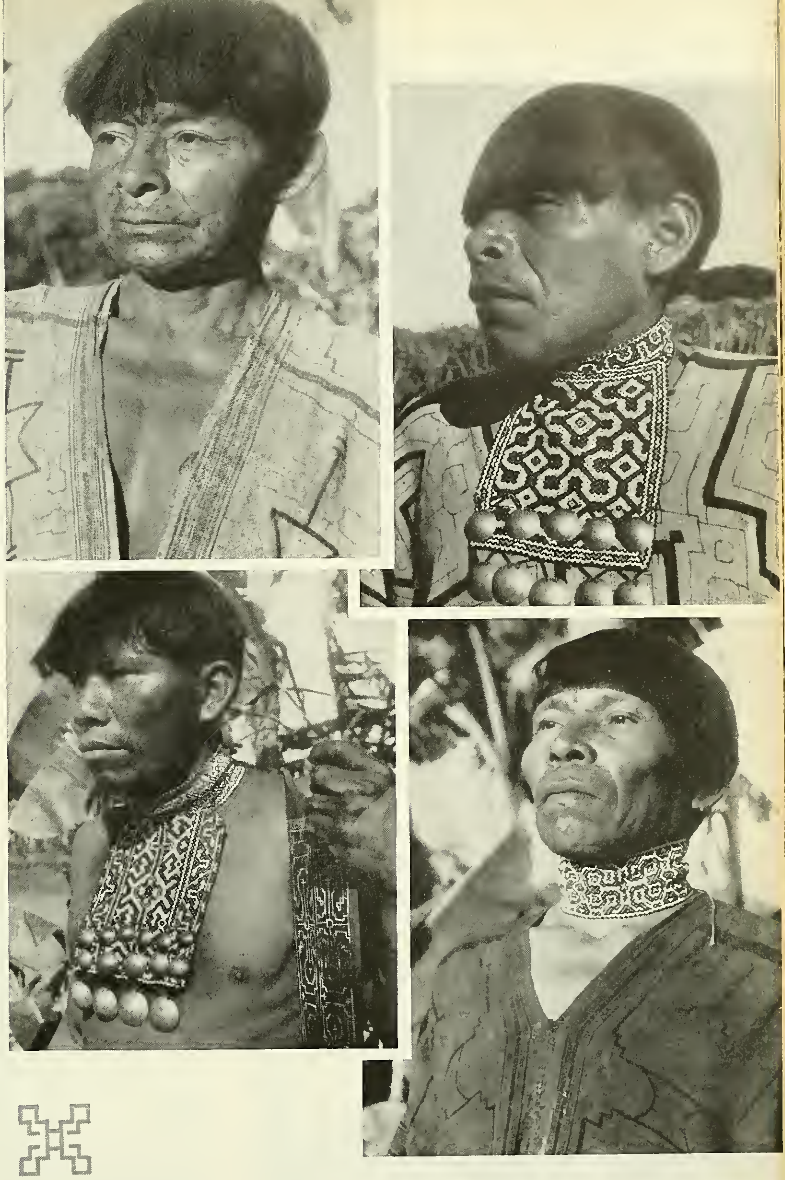
I was overwhelmed and immoderately flattered. Did it really take so little to win the good will of the traditionally aloof Conibos? Did my mere attention, my passive sympathy, place me in a category apart from other mortals?

At any rate, Raúl had said that it would be necessary to take the launch back to Pucallpa for an overhaul. It would be an excellent opportunity to visit a Conibo community.

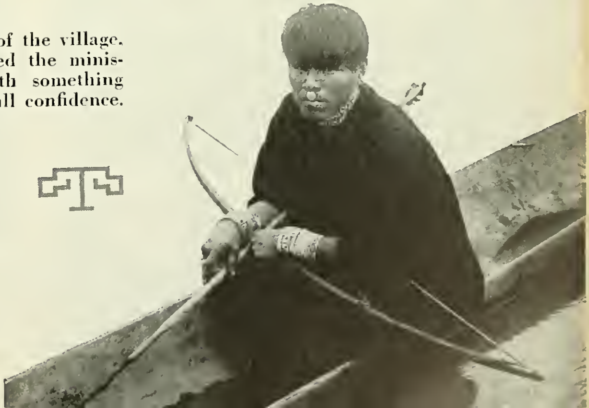
"Yes, Gustavo, I will be glad to visit you in Porvenir."

Before we returned to Iparía, Gustavo had exacted additional promises that the Piros would be dismissed, that Santiago would be reprimanded for his facetious remarks, and that no further reference would be made to Gustavo's scars.

Porvenir is an island some two days below Iparía by motor launch. At the mouth of the Río Tamaya the meandering Ucayali divides into two main channels, separated by several such islands. The islands in turn are divided by canals or *caños* which, during the dry season, are often low and treacherous.



HEAD MEN of the village, who watched the ministrations with something less than full confidence.



At mid-morning the launch entered the *caño* of Porvenir. The mouth was partly blocked by sand bars, upon which dozens of large crocodiles were sunning themselves. Egrets perched on submerged trees carried down by the last flood, while pink spoonbills fished among the driftwood. Gustavo stood on the bow, sounding carefully as the launch picked her way through the debris.

The north island was high and densely covered with rain forest. About a half a mile down the *caño* there appeared a clearing, and the gabled roofs of huge communal houses gradually loomed among the trees. The smoke of many hearths drifted above the jungle on the breathless morning air.

With a paddle Gustavo beat a signal against the side of the launch. The drumming re-echoed hollowly from the village beyond, and dozens of Conibos raced down to the water's edge. As the launch nosed into the mud, Gustavo jumped ashore with the small bag that contained his few belongings. He ignored us completely, conversing at length with a fellow-tribesman in the Conibo language. His face darkened, and he gave sharp, staccato orders.

Abruptly he wheeled. "The Doctór will stay here with me. Please remove his baggage. No, don't get out, *you*," he shouted at Santiago. "Just hand out the Doctór's baggage. Not the guns—there is little hunting around Porvenir."

I waded ashore while Gustavo's kinsmen rapidly unloaded my equipment and carried it off to the house on the bluff above.

This accomplished, Gustavo swept the launch with a frosty smile. "*Adiós*, don Raúl," he said. The other occupants of the craft might never have existed.

"See you in a couple of weeks!" Raúl shouted to me above the spluttering of the outboard. "Take care of yourself!"

The launch headed back toward the mainstream of the Ucayali. Gustavo watched until it disappeared beyond the sand bars. Then he turned to me.

"Welcome to Porvenir, Doctór. It may surprise you to know that I Gustavo, am the chief of the Conibos of the Tamaya River. Possibly my people number eight hundred, but I will tell you about that later. Now we must hurry. Get your medicines."

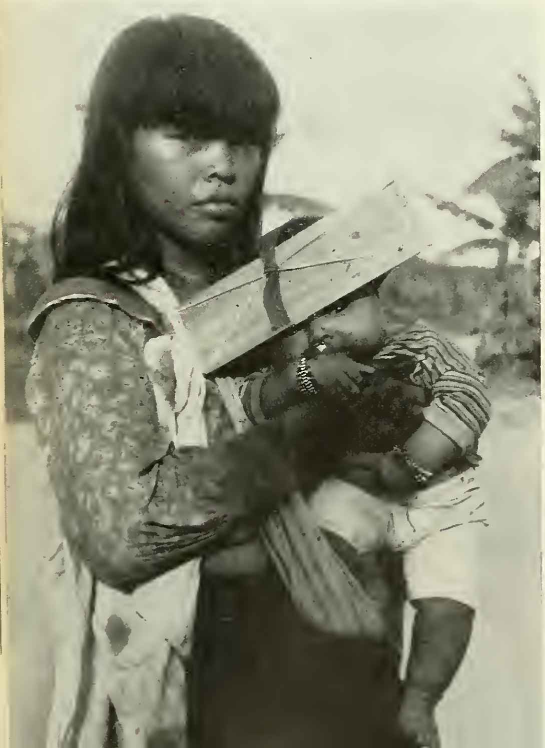
"My medicines?" A very ugly suspicion suddenly flickered through my mind.

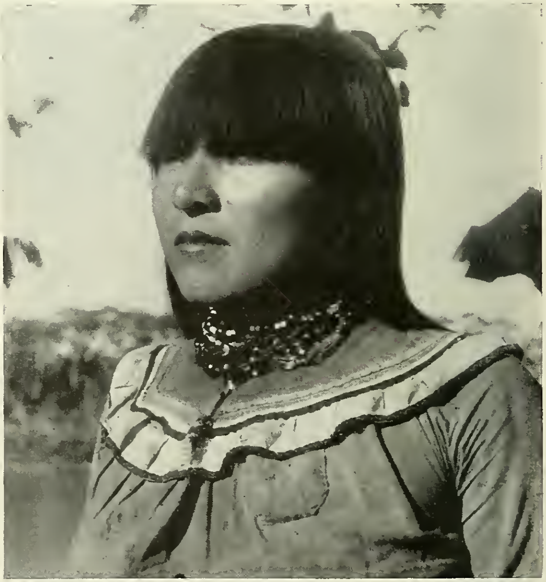
"You are a doctor, are you not?" Gustavo snapped impatiently. "Everyone calls you Doctór. Get your medicines! My cousin is dying."

The ugly suspicion became a certainty. I glanced around at the circle of stolid Conibo faces. They were neither hostile nor friendly. They were waiting. Gustavo glanced from me to them and back again.

In my mind I floundered about, searching for excuses. I am a Ph.D., not an M.D. *No.* I am only an academic doctor. *No.* I am not the kind of doctor that can cure anyone. *Definitely no!*

The Conibos stared and waited.





< Gustavo's daughter. The baby is undergoing the conventional Conibo head deformation.

^ The daughter-in-law of Gustavo. She is the wife of the man on the cover.

Women mourners butchering a pig for the feast (at left) and holding their vigil near the body (above).

"Gustavo," I finally managed, "if your cousin is dying, let's go to him at once."

Maybe he isn't dying, I thought. Maybe he has something I can cure with one of the wonder drugs I have, even if I don't know how to use them properly.

Gustavo seemed pleased. We commandeered a canoe and paddlers and proceeded swiftly up the *caño*. The Conibos followed at a run along the bank above. Where steps had been cut into the steep clay bluff we clambered up. The big house in the clearing was deserted but beyond it, near the edge of the forest, was an open-sided thatched hut, surrounded by a crowd of silent women and children. They parted to let us enter.

"My cousin," gestured Gustavo. "You will cure him."

On a mat in the shade of the palm thatch lay an old, emaciated man. Except for a loin cloth, he was naked; bones and tendons were outlined by his hot, dry skin. A thin yellow foam covered his lips. The only visible sign of life was the convulsive twitch of his abdomen.

"Tell me about his illness," I asked helplessly.

"He was sick when I left," Gustavo said, "but now he is worse. This medicine man says that he has vomited for the past week. Nothing makes him better. Cure him!" The last was an order.

The medicine man shot me a sullen look and glanced away.

This was no time for evasions or excuses.

"Send for my medicines and bedding, Gustavo," I said. "I will stay here with your cousin."

While my instructions were being carried out, I took the old man's pulse and temperature. The former was barely perceptible. The latter registered 104 degrees. In a silent circle the anxious relatives watched the proceedings.

The Indians returned to the bedside with my baggage, and I retired to the edge of the clearing to study my sole medical work, *The Red Cross First Aid Handbook.* I have no intention of belittling this very valuable contribution. It was simply not suited to my theater of operations. I consulted the index under "vomiting," and was advised, in case of persistent vomiting, to take the patient to the nearest physician. Pucallpa and the nearest physician were two days away by motor launch.

"Well," said Gustavo, "what does the book say?"

"Boil some water," I yelled. This was standard procedure. Keep them busy, I thought. Vaguely I remembered that sedatives had been known to stop convulsive hiccoughs. Maybe sedatives would stop convulsive vomiting.

When the water had cooled, I administered a capsule. Miraculously, it stayed down. Within an hour the convulsive twitch had stopped, and I became bolder.

While the Conibo medicine man watched with growing irritation, I fed the patient at two-hour intervals with orange juice, sweet tea, and broth made from beef cubes. His pulse quickened, his temperature went down, and eventually his eyelids flickered.

I was impressed with my curing powers. Like a fool, I treated the medicine man with condescension. I had pulled off a marvelous cure, and I rode the crest of the wave.

All this time the Conibos had been most solicitous of my comfort. They had fed me well and brought me all kinds of titbits from the jungle. I was waited on hand and foot. Overconfident, I overplayed my hand.

"Tomorrow," I announced to Gustavo,"I will move back to your house. It is uncomfortable here on the edge of the jungle, camping out in this flimsy shack. Your cousin is now out of danger. I will attend him several times a day, although it is clear that he is nearly well."

The next afternoon I moved back to Gustavo's house. After an early dinner, I retired to my mosquito net to read. I went to sleep early and slept soundly.

The mist of early morning still hung like a curtain in the *caño* of Porvenir when I was kicked savagely through the mosquito netting.

I came to life slowly.

"Wake up, *you fool,* he's dead," Gustavo shouted. He was gray and shaking. He kicked me again, and I rolled out and began to dress.

The normal morning calm of the household was broken. Cooking fires smoldered unattended. No one had bothered to roll up the mosquito nets and sleeping mats. The floor of the great house was littered and unswept. While I hurriedly dressed, a line of wailing women walked slowly through the clearing. Over their chorus of lamentation, Gustavo shouted orders to his sons, who departed on the run to various parts of the village.

Once the honored guest, I was now completely ignored. I breakfasted on powdered coffee and crackers, feeling both out of place and apprehensive. Gustavo stalked back and forth, his fists clenched.

Then the head men of Porvenir began to arrive. They were dressed in their best *cushmas*, their faces painted in black and red designs. They all carried heavy double-bladed clubs, standard Conibo gear for important occasions. As each man entered the house, he downed a large bowl of manioc beer served by Gustavo's youngest wife.

I sat on the bluff above the *caño* and stared out at the main stream of the Ucayali. A river steamer came into view briefly in the distance and disappeared beyond the wall of jungle. The Conibos continued to gather. They sat about on mats and all talked at once in excited voices. The beer flowed freely. Now and then they glanced at me with expressions I could not read. They were probably planning the funeral. I fervently hoped they were not discussing two funerals.

It was then that I noticed it. When we had arrived at Porvenir only a few days ago, dugout canoes had been moored before every house along the *caño.* Not a canoe was now in sight. The young men could be out fishing, I told myself. There could be any number of explanations. I walked up and down the bank, looking out at the Ucayali. Porvenir is an island, I kept thinking. Across the *caño* a crocodile slid lazily into the water.

Awaiting the Verdict

The Conibos continued their noisy discussions, and their voices grew louder. They had been drinking quantities of manioc beer. The medicine man glared at me speculatively and slid a thumb along the blade of his club. I ignored him. An unpleasant memory plagued my mind. "Not the guns," Gustavo had said to Santiago, "there is little hunting in Porvenir." In the distance a motor chugged along the Ucayali. It might as well have been on Mars.

Gustavo detached himself from the group and strode over to me.

"You are wasting your time, Doctór," he said softly, "you have a little machine that records human speech and music." He looked me up and down. "Up the *caño* of Porvenir there is music," he continued. "They are burying my cousin. Why don't you record it? It isn't as though you didn't have a part in the event."

Doing something, at least, would take my mind off my problems. I collected the tape recorder and a camera and started down the path above the *caño* to the house where Gustavo's cousin had lived. As I walked through the canebrake and plantain groves, the shrill lamentation of the Conibo women became louder. I have never heard a sound so expressive of grief and the presence of death. It began as a high falsetto wail, drawn out and sustained, and ended in a choking sob.

Some two dozen women, black shawls hiding their faces, sat in a line in the thatched hut where the old man had died. Between them and the jungle was a canoe, and in it Gustavo's cousin lay in state. He was dressed in his best white *cushma*, beautifully painted with geometric patterns. His body had been oiled and perfumed, his hair dyed blue-black, and every visible inch of skin had been painted in finely drawn designs in black, red, and yellow. Bunches of fragrant herbs rested beside his head, and bundles that probably contained funeral offerings were placed at his side.

Four elderly men were fashioning a wooden coffin lid with machetes. While I set up the recorder, feeling callous and irreverent, they placed the lid on top of the canoe and began to nail it shut with hardwood pegs. The funeral lament surged again, punctuated by the pounding of the hammer stones. A pole was bound to the canoe-coffin and, shouldering it, the men started off for the jungle, staggering under their load. Slowly the women followed, wailing and sobbing. At the edge of the forest, a man grabbed me roughly and shouted in Conibo. I did not understand the words, but the tone was unmistakable. I stayed behind in the clearing. The wailing faded away among the trees.

It was growing late and I realized dimly that I had eaten nothing since early morning. The clearing was deserted, and I stole some mangoes from a tree that grew beside the house. The silence was profoundly depressing. Above the dark waters of the *caño* the sky was streaked with the yellow of sunset. High above and miles away droned a Peruvian army plane, patrolling the Ucayali.

Suddenly Gustavo entered the clearing and walked up to me.

"Well, Doctór, we have decided," he said simply.

I felt numb. What a fool I have been to allow myself to get involved in such a situation, I thought.

"We have decided," he continued, "that my cousin had been sick for a long time. You made him better, but he was an old man. It was his time to die."

He took my arm. "Come have something to eat," he said.

LETTERS

A Friendly Jay

SIRS:

In the spacious parking place in All Saints Episcopal Church in Pasadena there are many blue jays, and one male has become my special friend. He comes almost as soon as I enter the parking space. I am ready with sunflower seeds and set up a tripod, upon which he perches. If I walk to the back of my car, he follows. And if I get into the car, he comes right to the door.

I thought your readers might like to see this photograph of him.

BENJAMIN FRANKLIN ROOT
Pasadena, California

Copper Sulphate Forbidden

SIRS:

It has been called to our attention that in the April, 1955, issue of NATURAL HISTORY an article entitled "Meet and Eat the Octopus" describes the taking of octopus by means of copper sulphate. We feel it should be brought to the attention of your readers that the use of copper sulphate to take any fish, mollusk, or crustacean is prohibited in the State of California . . . While Mr. Daetz' article did not specifically refer to California, we feel that a number of persons might very easily take up this practice in this state. The use of copper sulphate is prohibited in California . . . because it can kill all fish and plant life in the particular tide pool in which it is being used.

ROBERT G. KANEEN
Patrol Captain
Terminal Island, Calif.

Coconut Soda

SIRS:

Your article "Consider the Coconut" was especially interesting to us after observing its use in this part of the tropical world. Like Marco Polo, we like to drink Air Kalapa Muda (Young Coconut Milk) directly from the fruit with a straw. This is especially popular with the children. When fresh from the tree, it seems to have a carbonated taste. Another use is Coconut flour (Tepung Kalapa), manufactured here in Indonesia now. It is used in our family as an ingredient for cakes and cookies, where it adds interesting texture as well as flavor. It might well become a profitable export item, we think.

KEITH HINCHCLIFF
Djakarta, Java

Please! Not the Ax

SIRS:

I have read with great interest your article in the May issue on "The Natural Treasures of Big Cypress Swamp."

Our white pines and hemlocks are gone and now most of our big cypress in Florida are a thing of the past.

Mention was made in the article on "The Giant Cypress" at Longwood, Florida, estimated to be 2500 years old.

Through the efforts of Mrs. Helen Curlett Cole, a noted conservationist and arborist, this tree had a large metal marker and a high metal fence around it. Some vandals in the past few years have torn down both and, who knows, the axeman may take the tree next.

HAROLD N. COLE, M.D.
Cleveland, O.

Exploration News

A Prehistoric Louisiana Village

A MOUND in the shape of a flying bird looming 70 feet above the surrounding flats has recently been excavated, and it proves that Indians of an advanced stone age culture lived in Louisiana at least 2700 years ago. Their initial settlement marked the beginning of what may be called the "American Neolithic" period, according to Dr. James A. Ford, Associate Curator in North American archaeology at the American Museum of Natural History, who directed the excavating. The findings represent the oldest known village in the lower Mississippi Valley according to Dr. Ford, who is now studying and cataloging some 800 pounds of archaeological materials recovered from this site at Poverty Point, 5 miles northeast of Epps, Louisiana. Working with Dr. Ford at the site from February through May of this year were Junius C. Bird, Associate Curator of Archaeology at the American Museum, and Stewart Neitzel, Archaeologist with the Louisiana Parks Commission. The mound is the second highest Indian mound in North America.

The remains of the village itself, a few hundred yards east of the great mound, form a half-octagon measuring about three-quarters of a mile in diameter. The houses were built on artificial ridges that formed concentric octagons. Another smaller mound, some 56 feet high and lying to the north of the village, is also built in the shape of a bird. That the mounds were both artificially constructed is proved by the imprints of baskets used to carry clay for their construction. The absence of human artifacts in both mounds indicates that they served some purpose other than habitation.

Dr. Ford identifies the settlement with the cultures that stemmed from Asia by way of Bering Straits rather than with the high culture centers that later developed in Central and South America. Evidence supporting this includes a fragment of a tubular pipe similar to the pipes that have been connected with magical cures in northeastern Asia for several millenniums. These are not smoking pipes but are used for blowing and sucking in the practice of primitive medicine.

Before this site was excavated, archaeologists believed that pottery-making was unknown at the time of the Poverty-Point culture. Prehistoric inhabitants of this village had begun to make clay pottery as well as utensils of copper and sandstone. They also used hematite bolas (throwing weapons) and fashioned jewelry out of quartz and jasper. The villagers obviously traded with people of other regions for materials not in their environment.

Use of bird effigies, both in earth mounds and on vessels and ornaments is not uncommon in "American Neolithic" cultures. The large bird at Poverty Point appears to be flying within a single degree of true north, and the smaller mound is headed equally close to due west. The implied knowledge of astronomy, together with the geometric design of the village, suggests a greater familiarity with the rudiments of science than has been attributed to such aboriginal Americans.

Readers of NATURAL HISTORY Magazine will have opportunity to learn more about the life of the ancient Indians of Poverty Point in a forthcoming article.

"Wakamba," filmed in Africa, has exceptional photography and sound recording.

The Screen

Authentic comments on films in the field of nature, geography, and exploration

Edited by Elizabeth Downes

Wakamba

Reviewed by Harold E. Anthony
Deputy Director
The American Museum of Natural History

THE Wakamba are a native people dwelling in central East Africa. This film combines fact and fancy to give some idea of their community life and of the wildlife of the region where they live. The plot deals with the experiences of a man and a girl who want to marry. The father of the bride-to-be demands a pair of elephant tusks as a price for his daughter. The ivory must be of great length to be acceptable. The greater part of the sequence shows the hunter, alone or with one companion, in pursuit of a big bull elephant which has a splendid pair of tusks.

The film, in color, is of exceptional quality and is supplemented by sound recording which is also of high quality and very sensational in certain climactic situations. The interest of the beholder is caught early and held through to the finish.

The factual side of the film shows the natives engaged in numerous village activities and in dancing and special ceremonials connected with a marriage. The film shots of wild mammals and birds are factual as well because the footage was actually made as one sees it. The association of events, however, is oriented to carry out the fantasy announced at the opening of the film.

The commentator draws upon the element of mystery in narrating the events, and fiction plays a large part. We are told that the suitor-hunter snubs the tribal witch doctor, and the first hunt is a failure in consequence. When he goes to the witch doctor for help he secures a magic arrow, which he and a companion poison; they then set out on a hunt that has the sanction of the witch doctor.

A dramatic assemblage of wildlife, surprisingly tame, is encountered and ultimately the big elephant is located. The magic arrow kills the elephant, and now the whole countryside is antagonistic to the hunters. The return to the village with the heavy ivory is a nightmare until the hero throws the magic arrow into the fire. Thereafter, the forest and plain revert to normalcy, and the hunters return safely.

There is a great deal of very interesting and unusual animal behavior beautifully shown in this film, and the realistic sound effects are a great addition.

Filmed by E. M. Queeny
and *released by RKO Technicolor*
Running Time: 82 min.

The Living Swamp

Reviewed by Harold E. Anthony
Deputy Director
The American Museum of Natural History

"THE Living Swamp" shows the Okefenokee region, a mysterious swamp area in southern Georgia, which has been set aside as a wildlife refuge administered by the U.S. Fish and Wildlife Service. Okefenokee is a Seminole word meaning the "land of the trembling earth." The fauna and flora are extremely interesting because the impenetrable character of much of this cypress swamp permits primitive conditions to prevail. The forest hung with Spanish moss, the waterways with alligators, otters, aquatic bird life and occasional snakes, and the interspersed dry land communities with their bear, panther, rattlesnake, and raccoon provide a stage setting with great possibilities for dramatic action.

This movie tells the story, in color, of much of the activity daily taking place in the Okefenokee, and includes several special events staged specifically for the camera. The film is accompanied by a narration which, for the most part, conveys a sound interpretation of what is taking place. But there are occasional lapses: For example, a museum man can

"Land of the Pharaohs" is a lavish spectacle that scrambles Egyptian history.

scarcely agree with the commentator's characterization of the rattlesnake and the panther. Also, some of the events are obviously staged with tame animals or individuals so conditioned to man that what happens cannot be accepted as normal. Man is obviously acting for the benefit of the camera in several sequences, and in a not very subtle fashion. It is to be regretted that one incident shows a mixed lot of snakes of several species, all of which had been dumped together into the water. This is poor stage setting, particularly in contrast to the uninhibited animal behavior portrayed.

Nevertheless, the discrepancies will be of minor significance to anyone but a naturalist, and the film can be recommended as an insight into a primitive wilderness of unique character.

20th Century Fox Cinemascope,
DeLux Color
Running Time: 33 min.

Land of the Pharaohs

***Reviewed by* Nora Scott**
Egyptology Dept.
Metropolitan Museum of Art

A FILM such as "The Land of the Pharaohs" must be judged on two counts, as entertainment and as a reconstruction of history, and it is with the latter that we are chiefly concerned here. The action takes place in Egypt, supposedly during the reign of Khufu, and concerns that king and the building of his tomb, the Great Pyramid. This might have been a refreshing change from the novelist's favorite choice, the Amarna age. Unfortunately, few if any of the episodes bear any possible relation to fact, while no use has been made of the material remains of the period, though we know about Khufu and his family in fascinating detail, thanks chiefly to the Egyptian Expedition of the Boston Museum of Fine Arts, and have furniture and jewelry which they actually used. The costumes of the picture are a Hollywood designer's dream and the furnishings are the usual reproductions of biers and boxes from the tomb of Tutankhamun. Only the pyramid itself looms in the background, scrubbed for the occasion, as we have been told, with wire brushes.

It is difficult to grasp the enormous extent of the age of the Pharaohs; Khufu lived about 1300 years before Tutankhamun, almost as long as Tutankhamun lived before our own era. Camels, constantly plodding across the screen, were unknown in Egypt for 2000 years after Khufu; water wheels were introduced 600 years after the camel. It would have been easier to forgive a distortion of history if the archaeological details had been correct, or even if the story itself had been interesting. But as so often happens with a "spectacle," the story itself and the puppets who play it are swamped. Our interest is held by a series of lashings, murders, fights-to-the-death and throwings-into-crocodile-vats, leading up to a climax in which the villainess is entombed alive in the sarcophagus chamber of the pyramid. All together this picture may be put down as science fiction on a colossal scale.

Stars: Jack Hawkins, Joan Collins
and Dewey Martin
Warner Bros. CinemaScope and
Warner Color
Running time: 106 min.

Films previously reviewed

Documentary and Grade A	**What the Experts Said**
The Great Adventure Dramatized account of a young boy's experience with wild animals around a Swedish farm	Exceptional wildlife photography
Hunters of the Deep Undersea life filmed in color	An excellent opportunity to become acquainted with the ocean's depths
White Feather Opening of Cheyenne territory to whites in 1870's	Excellent costuming and set direction
Down the Alphabet	
Green Magic South American safari film of the Bonzi expedition	Good entertainment but many inaccuracies
Land of Fury First feature length movie filmed in New Zealand	Breath-taking scenic views, re-creation of native life skillful, plot confused

continued from page 343

carefully because it provokes thought. Many readers will undoubtedly wish to read, if they have not already done so, the fuller accounts from which these selections have been made.

Harold E. Anthony

SORCERERS' VILLAGE

by Hassoldt Davis

Duell, Sloan and Pearce and
Little Brown, $5.00
334 pp., 52 illus.

THIS book is an account of the author's recent travels through the Ivory Coast. Mr. Davis places particular stress on the phases of African life that involve magic, sorcery, cannibalism, and even communism. He includes a haunted well, the legendary elephants' graveyard, sacred monkeys and sacred catfish, ritual murders and patricide, sanguinary sacrifices and the coronation of a West African king, nudism, and dancing. There are masked dances, snake dances with the black cobra, and acrobatic dances in which children are tossed through the air, barely missing the dancer's knife.

It is difficult to place this book, or to characterize its author, although Davis refers to himself both as ethnologist and explorer. The book is not an ethnography, although it is largely concerned with African customs. The author disclaims sensationalism, but searches for the sensational aspects of African life. Moreover, customs that should be well known through previous studies are treated as surprising, new discoveries.

As an "explorer," the author and his wife retrace in part the travels of Seabrook (*Jungle Ways*, 1931) and Gorer (*Africa Dances*, 1935), to mention only two similar books, in their westward jaunt, which leads them to the "Sorcerers' Village." They travel with an assortment of modern gadgetry that is almost as surprising as their African adventures.

Through the narrative runs a personal thread—Davis's attempt to understand and explain to himself his urge to visit strange places, which he is unable to do in terms of either money or science. This book will appeal to kindred souls who seek novel experiences and an escape from the narrow confines of their lives.

William Bascom

THE ART OF PRIMITIVE PEOPLE

by J. T. Hooper
and C. A. Burland

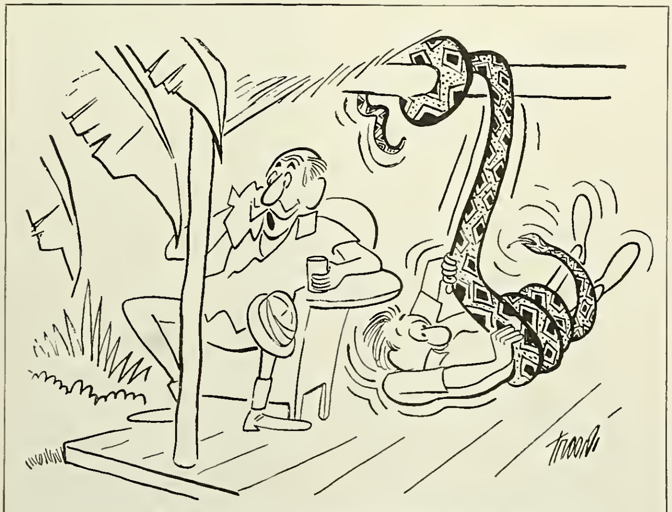
Philosophical Library, $7.50

THE first half of this book is a general text on "primitive" art by C. A. Burland in which he discusses such topics as the position of the artist in his society, the conditions that govern his art, the ideas he expresses and how they are diffused.

The second part, by J. T. Hooper, consists of a series of 68 plates of black and white reproductions of art objects drawn from various tribes of Polynesia, Melanesia, Africa, the Northwest Coast of North America, and the Eskimo. Each geographical section is prefaced by a brief précis of the area. The objects represented are interesting and in most cases quite typical. They are not, however, always the finest of their kind. This is perhaps the unfortunate result of restricting the choice of specimens to a single collection—Mr. Hooper's—when a wider selection might have made available finer pieces.

Mr. Burland's text, however, is a well written and useful presentation of a subject that is too frequently treated without reference to its creators.

Harry L. Shapiro



"Gads, Hughes—how do you find such energy in this inferno!"

THE INDIAN AND THE HORSE

by Frank Gilbert Roe

University of Oklahoma Press, $5.00
434 pp., 31 photographs, 1 map

IT is very difficult to visualize the Plains Indian without the horse. Through popular fiction and the motion picture, we have become conditioned to think of the nomadic redskin and his painted pony as inseparable, which is an indication of how thoroughly and completely the horse became integrated in Plains Indian culture. Yet, the western tribesmen were horseless as recently as 350 years ago, and the story of how they acquired their mounts and how the horse in turn altered their mode of life is a fascinating tale of truly epic proportions.

Frank Gilbert Roe has written what is probably the definitive book on the role of the horse in Plains Indian culture. He demolishes for all time the popular theory that the first horses to reach the Indians were strays from the expeditions of Coronado or De Soto and shows instead that they were acquired—along with European equestrian customs and gear—from Spanish frontier settlements of the early 17th century. Once they became common, horses revolutionized and revitalized the way of life of the Plains tribesmen much as the advent of the machine altered the culture of western Europe. Approximately half the book is devoted to a systematic description of the ways in which the horse modified hunting, warfare, and settlement patterns. With scholarly care the author evaluates the role of the horse in economics, social life, and the prestige system. There is even a chapter on horses and tribal psychology.

My chief criticism is that in emphasizing what the horse meant to the Indian, the author never really gives the reader a very clear idea of exactly how the Plains tribes used and cared for their mounts. This type of information, in fact, is conveyed almost entirely by the illustrations. These are well chosen and of high calibre, and some, of great historical interest, are here published for the first time.

Harry Tschopik, Jr.

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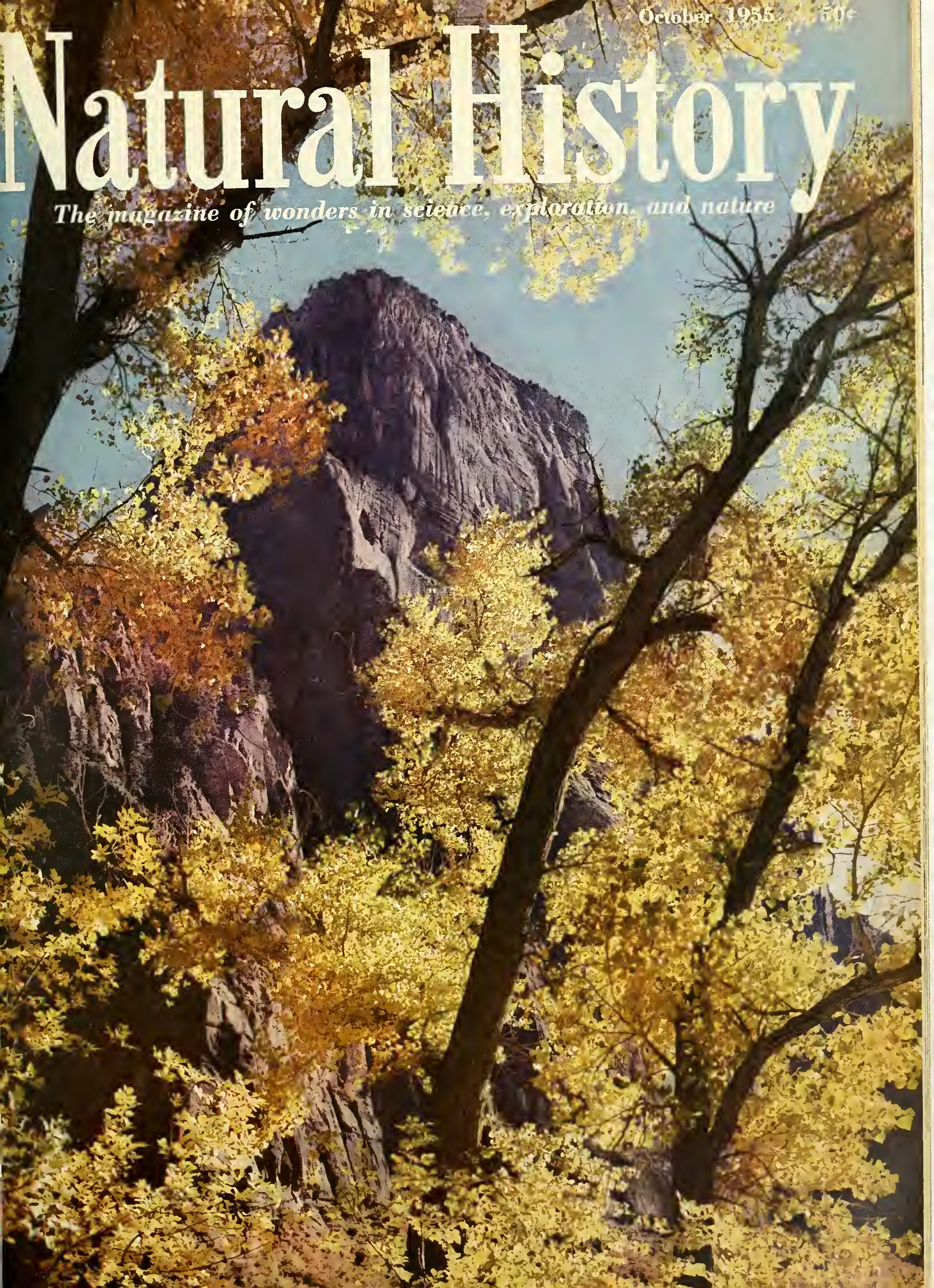

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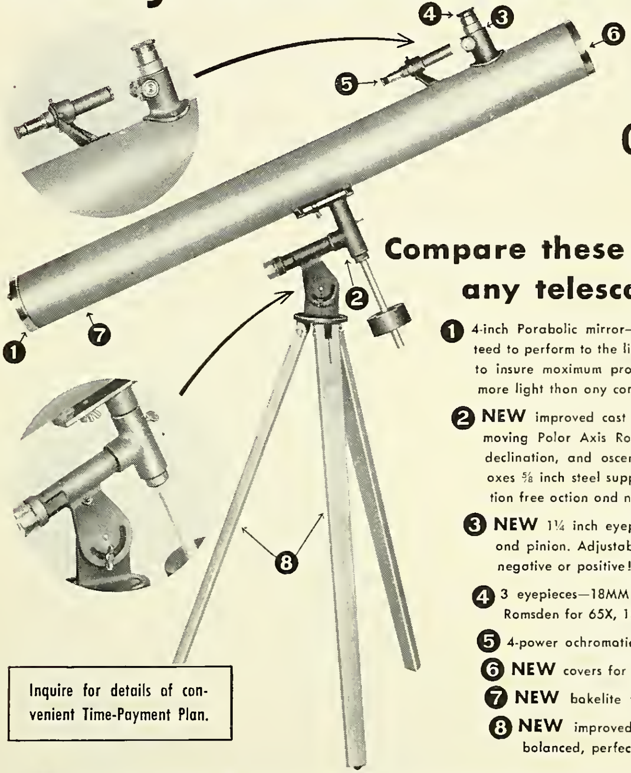

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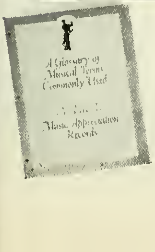
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October, 1955 Volume LXIV, No. 8

Zion National Park . . . . Cover Design
From a color transparency by Josef Muench

Your New Books 396

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The name of their tribe was a symbol of terror a century ago, but the Nazareth Zulus today are interweaving ancient tradition with western culture in a philosophy of peaceful growth

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Abandoned by his mother at two weeks of age, this rarely observed denizen of the Malay jungles became an interesting object of study

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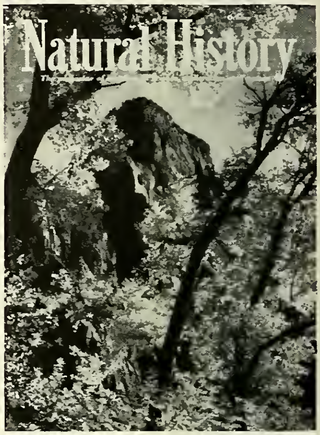

THE COVER THIS MONTH

The Great White Throne is probably the most famous of the rock formations that make Zion National Park a favorite tourist attraction in the West. In this color photograph, the rugged outline of the 6744-foot summit is framed by cottonwood trees in the full glory of their autumn coloring.

Zion was established as a National Park in 1919, and it embraces about 150 square miles in the southwestern corner of Utah. Its many beauties lie chiefly along the 14-mile gorge of the Virgin River, which flows through lush woodlands and meadows with spectacular cliffs and massive bastions rising on either side. Along its upper reaches, the canyon narrows to 50 or 75 feet at the bottom but is still about 1500 feet deep. A few miles south of the Great White Throne, the famed Mt. Carmel Highway climbs out a branch canyon to the east and passes through a mile-long tunnel high above the valley bottom, from which a breathtaking view can be had through windows in the rock.

The cover photograph was taken by the celebrated photographer Josef Muench.

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Mt. Rainier National Park, Wash.

The mountain that blew its top

Mt. Rainier, the most superb landmark of the Pacific Northwest, stands as a 14,408-foot monument to the constructive genius of fire and ice. Built by volcanic action, which some say eventually blasted 2,000 feet off its crest, the mountain today has 26 active glaciers, ranging in thickness up to 500 feet, that constantly grind away at its slopes.

In addition to its matchless glaciers, Mt. Rainier National Park offers excellent skiing and climbing, more than 240 miles of wilderness trails and some of the most eye-filling floral displays in the entire park system. Here you can explore the weirdly beautiful ice caves beneath a glacier or toboggan down its surface in special "tin pants". You can observe bears, blacktail deer, elk, the rare mountain goat and other forms of wildlife, living as they did before the white man came.

Named for an English admiral who never saw it, Rainier is nevertheless typically American in personality. When you see it dominating the Washington sky, you'll find it massive, colorful and spectacular – and you'll know, perhaps for the first time, the true meaning of "purple mountains' majesty"...

Sinclair Salutes The National Wildlife Federation

A nation-wide group of state organizations whose primary objective is the restoration, conservation and scientific management of our natural resources. The National Wildlife Federation is a non-profit, non-political organization with headquarters at 232 Carroll St., N.W., Takoma Park, Washington 12, D.C.

The activities of the Federation are financed by contributions and through the sale by mail of Wildlife Stamps and other nature materials. The Federation's work provides scholarships, fellowships, news and legislative reports, field and educational services and other programs designed to foster a greater understanding of America's outdoor heritage.

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Peruvian Llama

The original of this small Llama is of cast silver (the reproduction is silver plate with a pin-clasp attachment). Such figures of various sizes and metals were made by the Incas in the 15th and 16th centuries. 1½ inches long.

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Olmec Mask

The original of this outstanding example of Olmec sculpture was found in a cave in the State of Guerrero, Mexico. In this reproduction the remnants of Jade mosaic covering the mouth region have been "removed" to better show the subtle modelling of the whole face. 6½ x 8 inches.

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Smiling Head

The delicately modelled smiling heads such as this one are a happy relief from the usually grim and humorless faces of most Mexican sculptures. Smiling heads occur in the limited area in central Vera Cruz and date to about 1000 A. D. 10½ inches high including ebonized Alvastone base.

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THE MUSEUM SHOP

Effigy Vessel

The original of this vessel is a type of pottery known as Plumbate, one of the most interesting wares of Mexico and Central America. This vessel, found in the Republic of El Salvador, bears the face of an old man—perhaps that of the Old God common to many of the cultures of Middle America. 7 inches high.

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YOUR NEW BOOKS

Lowell Thomas: Great True Adventures • Humboldt Birds • Joseph Wood Krutch: On the desert

GREAT TRUE ADVENTURES

\- - - - - - - - - by Lowell Thomas

Hawthorn, $5.00
400 pp.

IN SELECTING 29 of "the world's greatest adventures," Lowell Thomas has shown nothing if not catholicity of taste. His tales come from the Bible, the Commentaries of Caesar, the history of Alexander the Great, and so down through time to the aftermath of the latest world War. They deal with strife, spying, escape, sport, commercial exploitation, humanitarianism, aeronautics, diplomacy, scientific exploration, and fool stunts. Some of the last were successful, or partially so, which apparently justifies their inclusion. Be it remembered, however, that a tenet of the serious investigator is that "adventure" is often an unwarranted interruption and the fault of poor planning!

The diversity of source indicates that there could be no harmony of purpose, mood, significance, or even of literary impact in the selections. What they share, according to the publisher's announcement, is "high-voltage" and the picturing of human beings "at the peak of their powers, the limit of their endurance, the summit of their aspirations." But the next claim is a fatal tail-spin, namely that "nearly all of the world's great adventures and adventurers are represented in this wonderful anthology!" (exclamation point ours). It would be an understatement to allege that a hundred well-read men could pick a hundred other collections of equal "voltage." Quite possibly a hundred other such books have *already* been published.

This is no belittlement of Mr. Thomas's choices, which include by special demand of his publishers, a worthy extract from his own book, *The Sea Devil*. Whereas many of the accounts in *Great True Adventures* are doubtless in the mind's dim storehouse of countless readers, others of obscurer source may well have been here rescued from oblivion. These include, for example, *New York to France in a Rowboat, We Crashed the Iron Curtain in a Tank*, and *Return to Gettysburg*.

R. C. M.

THE TREE OF CULTURE

\- - - - - - - - - - by Ralph Linton

Alfred A. Knopf, $7.50
692 pp.

IN THIS posthumous work, Ralph Linton's voice and thought are as characteristic as anything he ever wrote, which, of course, means that *The Tree of Culture* is a book of tremendous range, erudition, and persuasiveness. Linton long had this project in mind, and it represents the mature fruit of his own culture. He has undertaken no less a task than the story of man's slow and painful struggle to accommodate himself to his world, which, in this case, means through the mechanism of technology and social organization.

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ture, Linton proceeds to summarize the manifold story of the growth of civilization both in time and space, covering approximately 600,000 years and virtually the whole world. He stops short of the great civilizations of recent times but includes the classic world of the Mediterranean and what might be called the pre-European developments of civilization in the Near, Middle, and Far East. This is further than most anthropologists usually go, but it is amply justified by the insight into the origin and nature of these civilizations that anthropology can supply rather better than conventional history can or at least up to now has.

To my mind this approach to human history is far more successful than an attempt like H. G. Wells'. It deals with human rather than dynastic behavior and provides the reader with an understanding of his own world.

Linton's grasp of detail is enormous and is used with telling effect. It is perhaps unfortunate, but inevitable in covering so much territory, that his brilliant gift for generalization be a little uncertain here and there. One could wish that he were not always so ready with an explanation or a sweeping summation where the facts are a bit weak. But with this reservation, here is a book well worth reading.

Harry L. Shapiro

THE VOICE OF THE DESERT

by Joseph Wood Krutch

William Morrow, $3.75
223 pp., 13 drawings

THIS book is a series of thoughtful and well-written essays about plant and animal life in the American deserts and what they mean to the author. It does not profess to give you an over-all picture of desert life but rather some accurate accounts about a few selected forms. Among others, Krutch discusses the kangaroo rat who never drinks water, the relationship of the yucca plant and the yucca moth, the ways of scorpions, and the altitudinal distribution of plants and animals in the mountains that dissect the desert. The author is to be especially commended for his excellent chapter on conservation.

But the purpose of the book is not merely to relate facts; it also gives the reader the writer's philosophical interpretation of desert life. In the last chapter Krutch explains this in detail, and in many ways clarifies the philosophical thread that runs through the book. I feel that had it been an earlier chapter in the book, it would have revealed the underlying thesis of the book more readily to the reader. As Krutch is well aware, many biologists will disagree with his metabiology and "mystique," but they will find it nonetheless provocative.

One wonders how the statement crept into the book that the hundredth meridian lies roughly on a line drawn from Columbus, Ohio, to Oklahoma City? The former is at a longitude of 83° West, the latter at about 97½° West.

The book is illustrated by more than a dozen good black and white photographs.

B. M. Hecht

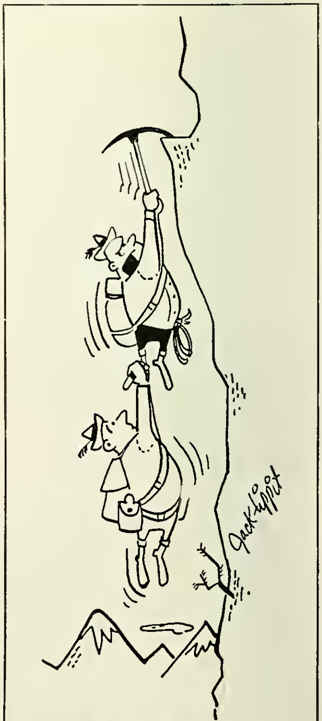
HUMBOLDT

by Helmut de Terra

Alfred A. Knopf, $5.75
386 pp., 3 maps, 8 illus.

ALEXANDER VON HUMBOLDT (1769-1859), uniquely wide-angled *savant*, explorer, cosmographer, biologist, diplomat, engineer, and best-known world citizen of his long lifetime of activity and prestige, is today a relatively forgotten man. An intellectual heir of Pericles and Leonardo da Vinci, he was perhaps the last universally-educated human being to survive until the age of specialization. Throughout decades of the two centuries preceding the present he numbered among his intimates Agassiz, Ampère, Bolivar, de Candolle, Chopin, Cuvier, Faraday, Franklin, Frederick the Great, Gauss, Goethe, Herschel, Ingres, Irving, Jefferson, Lavoisier, Liszt, Lyell, Morse, Pitt,

continued on page 441



"Turn loosa' my foot, Stupid . . .
or I'll hitcha' with this pick!"

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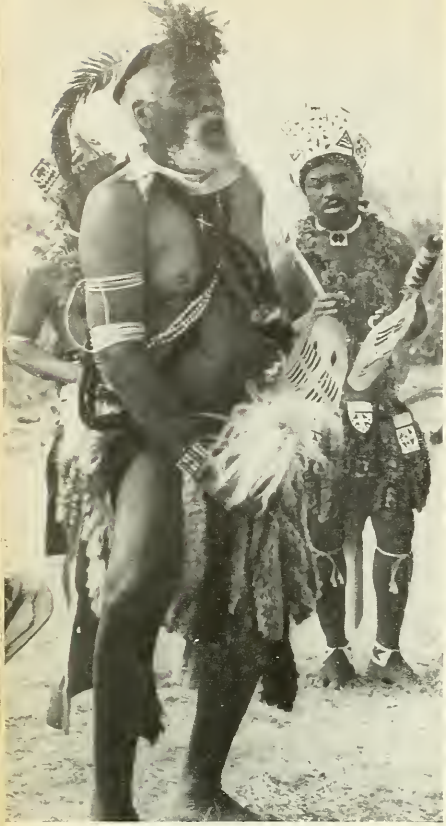
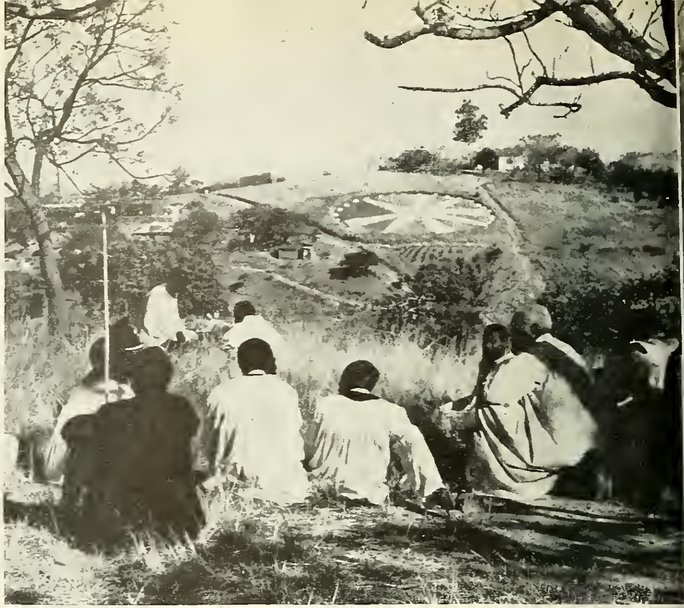
City & State ....

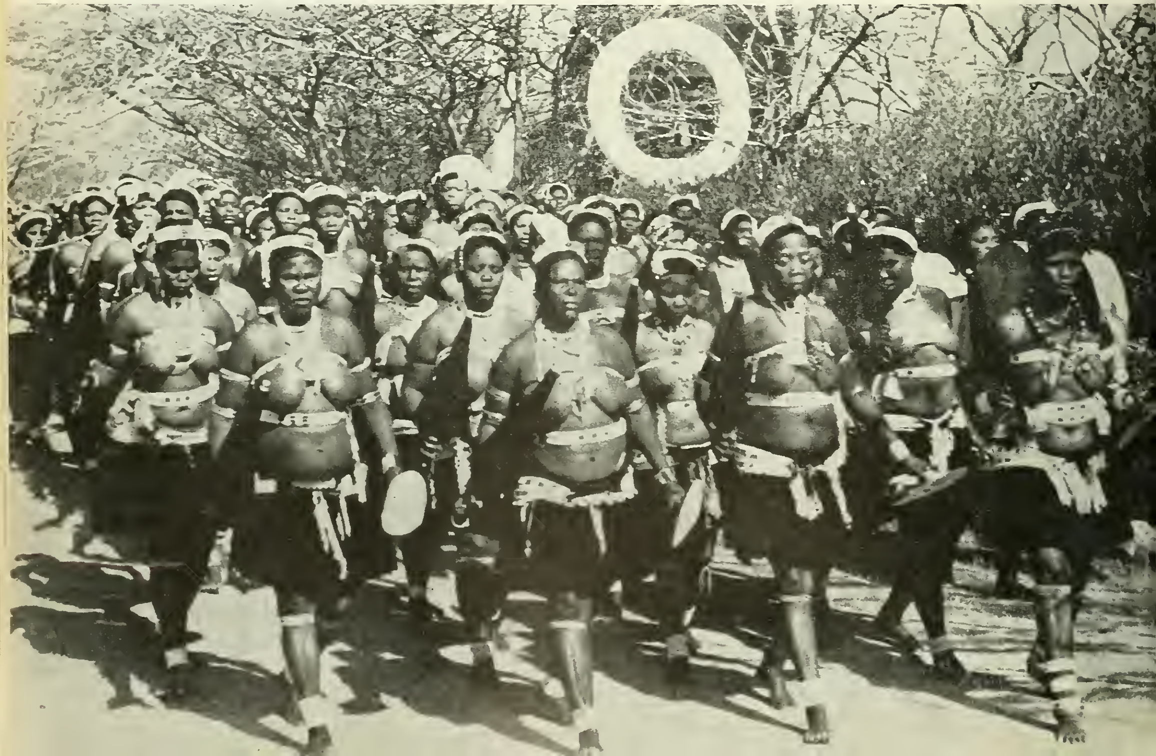




▲ Elders of the Church of Shembe, looking toward one of the sacred syn
bols made of white-washed stones. It is believed to represent Halley's Come

◀ One of the older Zulu men dancing in the group of worshippers who prefer to use traditional dress.

▼ Senior unmarried Zulu women—Lasses of Nazareth—advancing to the dance after prayer. The white circle is one of Shembe's sacred symbols.



The name of their tribe was a symbol of terror a century ago, but the Nazareth Zulus today are interweaving ancient tradition with western culture in a philosophy of peaceful growth

▲ **The Reverend Johannes Galilee Shembe**, son of the founder, with one of his chief elders, Ngcobo, the Gate Keeper.

Zulus find the Middle Road

By Hugh Tracey

Director, International Library of African Music
Photographs by the author and by Anne and Wayne Fredericks

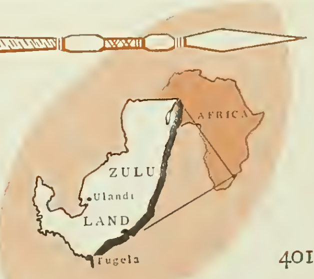
Americans who may draw their impressions of Africa largely from the newspaper accounts of Mau Mau atrocities, from hints of communist infiltration, or from discord over racial segregation may like to know that something quite different is happening in Zululand.

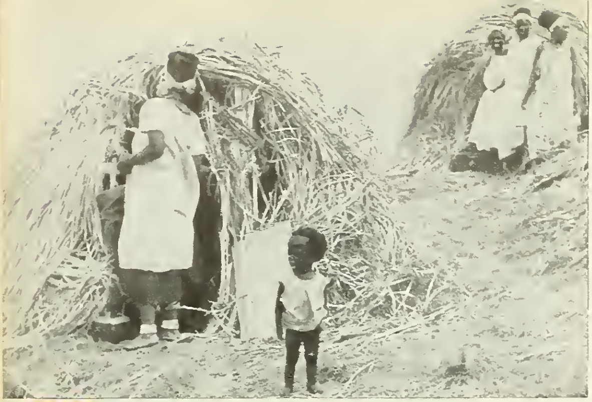
The story of Isaiah Shembe, the Zulu prophet, begins in the early days of this century and is as simple as a medieval woodcut. His father had found work upon the highlands of the Orange Free State among the white farmers. Here he was among non-Zulu Bantus of various tribes who are collectively called Sotho. Isaiah Shembe was a serious boy, and he took his reading and writing lessons at the nearby Methodist Mission earnestly. He read the Old Testament both in its Zulu and Sotho translations and was fired by its heroic stories, for they resembled the ones his father had told him concerning the great days of the Zulu chiefs.

The Zulus had sprung into prominence from a small clan a little

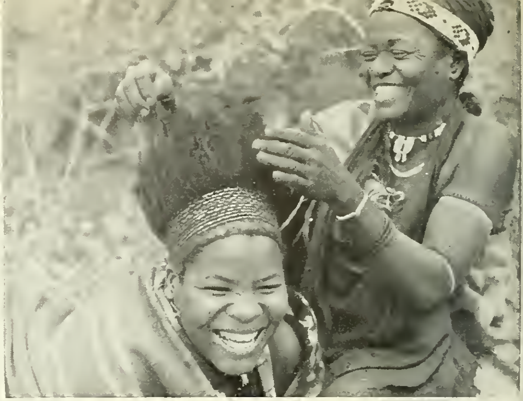
THE ZULUS

At the close of the 18th century, the Zulus were an unimportant tribe numbering only a few thousands. Through warfare, accretion, and natural increase, however, they became one of the major forces in the history of South Africa. British troops defeated them decisively in 1879. By 1921 the population of Zululand had reached a quarter of a million, and a recent estimate puts the figure at 387,113. This gives no indication of how many Zulus there are, however, because most of them no longer live in Zululand but farther south in Natal within 30 miles of the coast. The total number may even exceed two million.

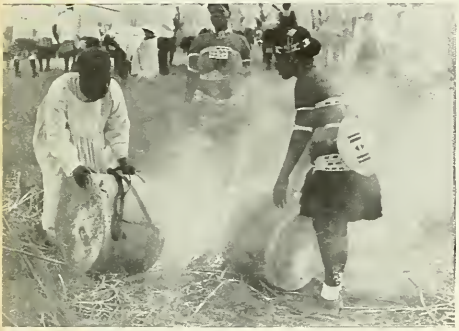




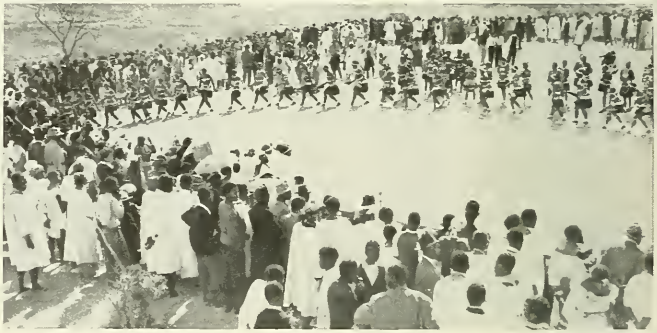
▲ Bivouacs in the married women's section on the sacred hill. Nhlangakazi, during the January rites.



▲ A young Zulu having her hair done for the dance by her mother-in-law. Shembe revived traditional styles.

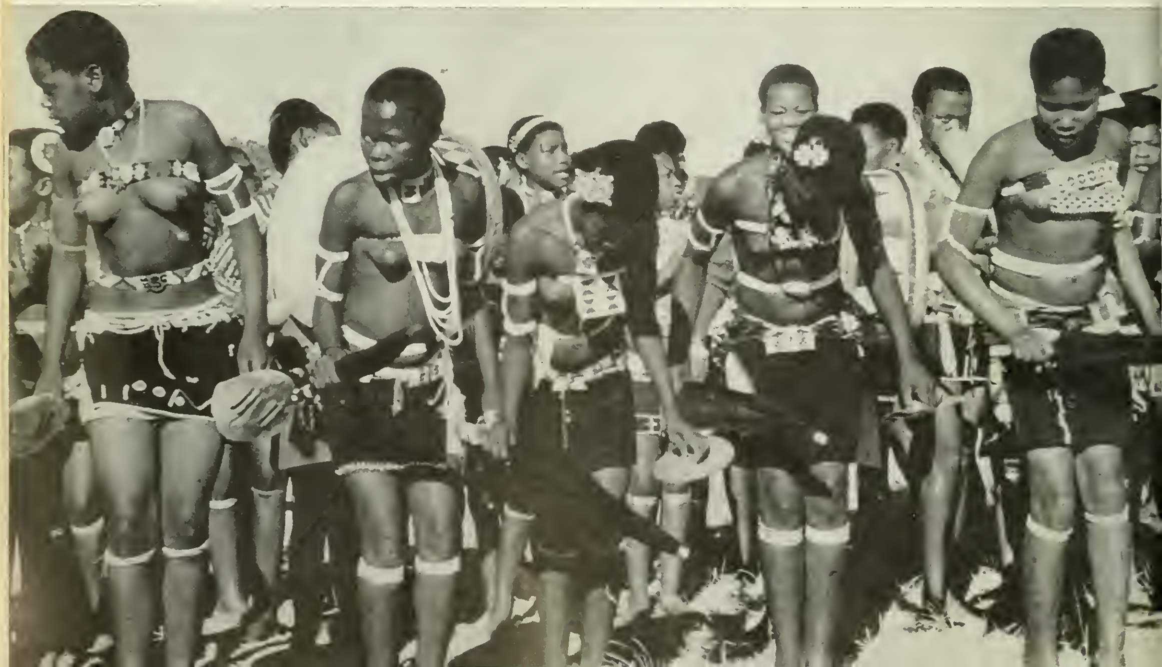


▲ In wet weather. the drums need to be heated to make them resound well.



▲ After several days of preparation. including a three-hour religious service, the dances begin. The elder unmarried women are seen here.

▼ The young unmarried girls carry parasols but otherwise adhere to Zulu style when performing the dances.



Three elders of the Church of Shembe in their daily garb. At right: The Reverend Fred Ngoma, chief evangelist.

over 150 years ago. Soon they were writing their history across southern Africa in large red letters. Zulu life became a continuous pageant. A thousand spearmen would dance together, and a hundred cattle would be slaughtered to feed the young men, whose singing was like the breaking of waves on a shore. The poets flourished, creating their lines in ecstatic adulation of greatness as they knew it.

Then the tide turned. In 1879, on the plains of Ulundi, the guns of the British brought the aggressive Zulus to a standstill. The most homicidal tribe in all southern Africa, which at that time numbered a quarter of a million, was obliged to turn their spears into hoes and their shields into boot leather.

New Life in Old Pattern

When the young Shembe read of John the Baptist and learned that total immersion had been the rule in those heroic days, he tried to get the local minister to rebaptise him. He was refused and in consequence went over to the Baptist Mission. This was the turning point in his life. Shembe had caught the edge of a vision—a design that matched the spirituality of his own people.

Returning to the lowlands, he became an itinerant preacher among the Zulus who were working for white men in the town of Durban. But the native quarter of this seaport did not seem to nourish the spiritual dignity he felt sure was the birthright of all his people. So he preached throughout the near-by Valley of a Thousand Hills and saw a way of life developing in harmony with his dream. Belief in his own Zulu interpretation of the Bible became a conviction, and the conviction was dramatically crystallized by the appearance of a star.

The year 1910 was the year of Halley's Comet. With this heavenly prodigy for all to see, Shembe's Church of Nazareth became a fact.

He founded a village called Ekupakameni—"Home." Here he would re-establish the way of life that had been delineated by the poets of old, temporarily lost in defeat, but now rediscovered in the sacred texts of the Old Testament. This site was to witness one of the most sincere experiments ever undertaken by an African community in practical Christianity.

The people of the new Nazareth, who had left their homes in town and country to live the spiritual life, revived the normal life of a Zulu village but with an important change. The ground was holy, and all shoes had to be removed at a

▼ Women dancing before the Reverend J. G. Shembe in the village.

white stone placed at the "gate" to the village. In this, Shembe was following the Book of Joshua.

For three years, Shembe continued to preach throughout Natal and Zululand, a hilly region 300 miles from north to south and 100 miles wide. The Zulu adored him; the English admired and recognized him for his transparent sincerity. Gradually he wove into the warp of Zulu thought the weft of Christian teaching, each strand unconsciously selected for its matching of the Zulu pattern.

At this stage, the new Zulu Church of Nazareth might have become static had not Shembe been both a visionary and a man of action—a rare combination in Africa. Early in 1913, he was preaching some 60 miles north of his village, where the Tugela River twists its way through a tumbled mass of hills and cliffs. While sitting in a small Zulu kraal, he received a vision. A voice he felt sure was that of the Lord, called him to go far to the south, to a hill called Nhlangakazi, to receive divine instruction.

He walked some 40 miles in two days and came to a lonely hill, rising in a cone over 1000 feet into the sky. There is nothing quite like it in Natal. It is crowned by a small flat summit. He climbed to a spur jutting out toward the east.

Enemies

Local men caught sight of him high on the skyline and went up to ask what he was doing on their land. He replied that the Lord had sent him there to receive a message.

Detecting his accent, they said, "Are there no hills in your Sotho country where you may speak to your God?"

"No," he said, "the Lord sent me to this hill, no other."

They told him to be gone or they would kill him.

Shembe stayed on the mountain for several days, but no message came. The men were angry and later returned with their dogs. But Shembe saw them and hid behind a boulder while they passed. The next day, however, four of them caught him. They beat him with their sticks till he was nearly senseless and then told one of their number to stab him. The man refused, saying, "Make me a murderer by myself alone? No, all together or not at all."

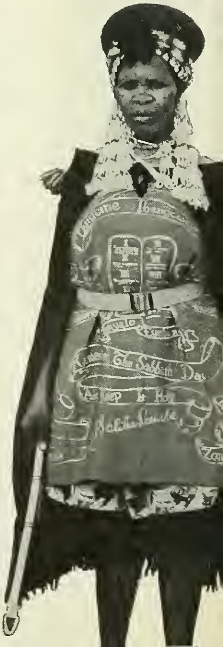
So instead they brought him to their chief, who realized that this was no ordinary man. The chief rewarded Shembe's sincerity by allowing him to stay in the village and continue his preaching in the district.

It happened that the chief's wife had been married for more than 12 years without bearing a child. This was a great sorrow, for among the Zulu to have no son is to have no future. Shembe foretold that the Lord would reward the chief's kindness by giving him no less than three sons. That year the chief's wife conceived and bore her first son, and she eventually added five more. This caused the chief to be-

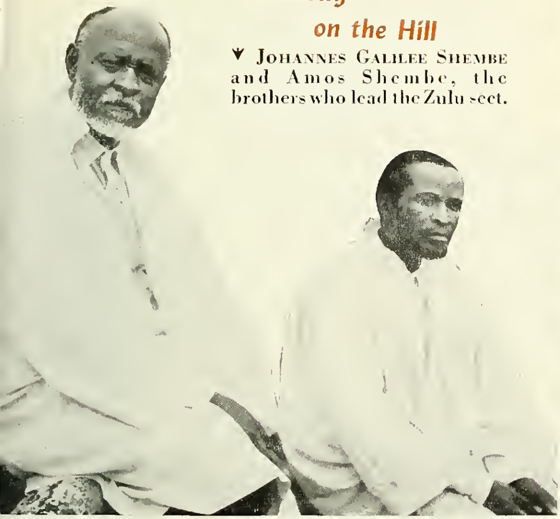
▲ **These women** are wearing the traditional hollow conical hair-do. It is colored with red ocher.

▲ **Girls** too young to dance on the chief dance days. They can dance separately when Shembe instructs them to.

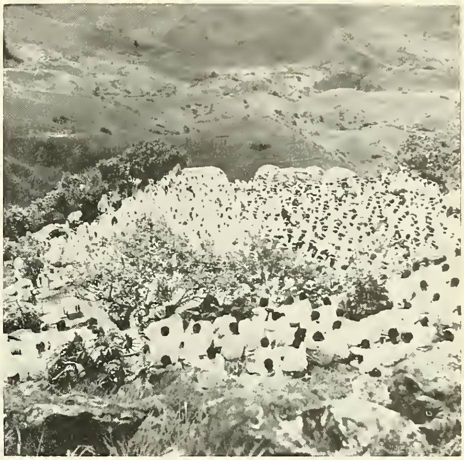
▼ **A devout follower** of Shembe whose dress displays the Ten Commandments and other texts.



Ceremony on the Hill



▼ **Johannes Galilee Shembe** and Amos Shembe, the brothers who lead the Zulu sect.



▲ **A service in the sky**: a distant view of an impressive ceremony last January in which almost 1,000 men, women and children took part.

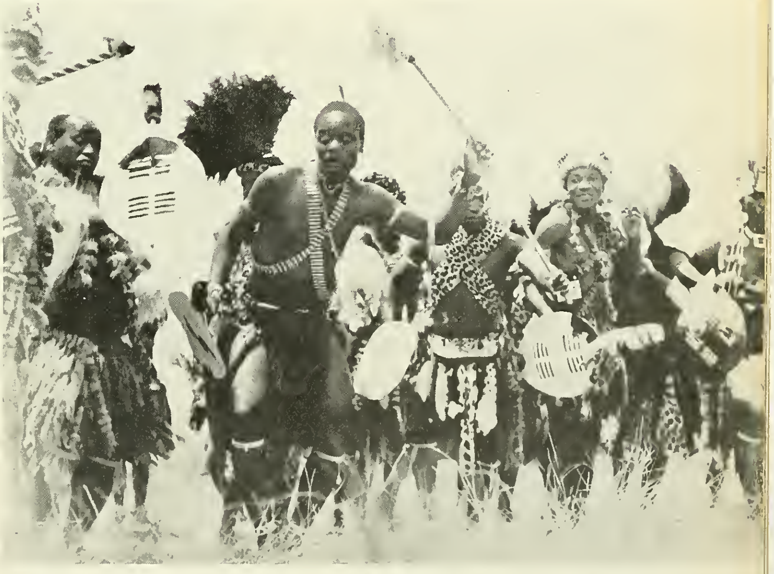
come one of Shembe's firm believers.

It is said that the people of this village asked searching questions: Why must the Zulus throw away their traditional dress, those leather kirtles, calfskins, and civet cat tails? Why, upon taking Christianity, must they give up their dances?

To answer these questions, Shembe needed divine guidance. He climbed the hill alone and prayed to God. This time the message came: it was not necessary for Zulus to wear clothing of European style or give up their dances to show their belief in their High God.

A Church for the People

From then on, the distinctive pattern of his Church of Nazareth was set. Shembe's follower wore the gala dress of their people when they danced for their religion, and the married women continued to tower their hair into the traditional red cone. Christianity had knocked on the door of their huts and had been welcomed to the warmth of the family circle around the cooking pots.



▲ **Zulu men**, members of the Church, who prefer to dance in traditional dress: The man in the center was considered one of the best dancers of all.

The rest flowed naturally from these two revelations, and Shembe, now called the Prophet by his followers, allowed his keen imagination full scope. He borrowed from one church the use of white surplices, from another the communion service, and from yet another the rejection of all medicine in preference for faith healing. Through an American missionary, he became convinced that Saturday and not Sunday was the Sabbath and ordained that all services should be held on Saturdays.

The hill of his revelations became sacred, and on its peak all his evangelists have been consecrated. Each candidate brings a stone to mark his dedication, and already a small mound of stones has formed on the spot where Shembe first knelt in prayer and received his guidance.

By divine injunction, two conventions are held each year, one on January 25 at the hill, and the other on July 25 at their village home.

The hundreds of men and women who gather for the latter are accommodated in large sheds and huts that are set aside for them. Unaccompanied married women segregate themselves in one place, unmarried in another, married couples in a third, and all the single men in their own place. This was the old rule in a Zulu village. The code of Zulu sexual morality is strictly observed in all its detail, whereas elsewhere there is increasing laxity. The convention is a period of great devotion, and all who dislike the hurry of modern life find great satisfaction in it.

For over 20 years, the wise and kindly prophet taught his scattered congregations throughout Natal in the art of self-reliance, teaching them to compromise with the foreign and to maintain a firm belief in Zulu intuition. Because the elderly people needed a place in which to retire in case of distress or poverty, he bought farm land and planted sugar cane. In addition, he set up a bus line and stores in out-of-the-way country districts; all funds were wholly devoted to the welfare of the community.

Never in his life as head of the church did he handle money. The management was left entirely to specially appointed elders. In personal matters, he was abstemious to a degree. If he required a new shirt, some one would present him with one before he was aware of the need. To ease the strain of walking hundreds of miles on his missions, his followers clubbed together and bought him a motor car. He only smiled, thanked them, and with the money bought another piece of land for the church.

In June of 1935, while on one of his journeys, he caught a chill, which brought on an attack of pneumonia, and death soon followed. He was brought home and buried Zulu fashion, in the center of the village, his body wrapped in a black bull's hide as befitted a noble. His believers could not have shown their grief more deeply if the greatest of Zulu chieftains had died.

A Successor

Anyone familiar with the usual trend of African religious movements might realize that Shembe's passing put the Church of Nazareth (now familiarly known as the Church of Shembe) into a critical phase. He had had three sons. Two of them had been educated at the college of Fort Hare in the Cape Province. To them the mourners turned. The eldest felt ill-equipped to follow his saintly father. The second, Johannes Galilee Shembe, after much misgiving and with great humility, agreed to undertake the leadership of the people.

The third brother, Amos, discreetly supported Johannes, with the diffidence befitting a younger brother in Zulu life.

After several years, the new Shembe found his father's precepts sound and became more confident. He did not succeed to the title of Prophet, but he led the religious dances, blessed the sick, preached the simple morality by which the Zulu people might direct their lives in a fast-changing world. He is called Great Father (*Baba Mkulu*) and has seen his following during twenty years grow from hundreds to thousands. The exact number is not known because Zulu custom decrees that it is unlucky to count people. You can only ask each person to put a stone on a heap and then later count the stones. No one has yet done so.

The difficulties of the Church of Shembe have been chiefly secular. The ramifications of business management have sometimes seemed baffling. On the spiritual side, the answer is written in the calm dignity and peaceful features of its adherents. This you see in the white-haired evangelist, The Rev. Fred Ngoma, and the "Keeper of the Gates," Ngcobo, both early converts now in their seventies, and in the young neophyte who on weekends slips away from his work in the near-by town to take part in the church dances.

The full depth of devotion is seen in the January convention, at the hill. In all weathers, a thousand or more adherents set out from Ekupakameni with pots and blankets on their heads to make the 30-mile pilgrimage. It takes them two or three days to reach the northwest slope of the hill and set up their camp.

Shembe himself, with the elders of the church, camps high under the face of the cliff. The leader spends most of his days and nights in contemplation in a small beehive hut, proudly re-built each year according to the Zulu tradition. Here for fourteen days, the people live high above the surrounding land. Twice daily they are called to their devotions by old Ngcobo. Donning their white surplices, the men and women alike climb toward the north shoulder of the hill. Shembe himself, in purple or green cassock and white surplice, walks slowly along the path beneath the cliff to the sacred place where their prophet used to preach 40 years ago. The sight of the Zulu throng, dressed in white, the rust red of the women's headdresses and the jet of the men's hair contrasting vividly with the soft blues and greens of the distant tapestry, is the nearest approach to an unconscious re-enactment of the Sermon on the Mount that one could ever see in Africa. The sermon and the Zulu voices rolling down to the valley 1000 feet below like the sound of a great organ take one back to the age of simple faith. Remote from the rest of the world, the followers of the Zulu prophet prove the poetic sensibility of their tribe in a perfect commingling of the old and the new.

Bertie – The SUN BEAR

By

James Alexander Hislop

Abandoned by his mother at two weeks of age, this rarely observed animal of the Malay jungles became an interesting object of study

▲ He took to bottle feeding with no trouble.

THE Malayan bear, *Helarctos malayanus,* or Sun Bear as it is called in the latest writings, is a forest animal that is rarely seen.

In the tall trees and thick undergrowth of the Malayan jungle, it is extremely difficult to observe wildlife. Large animals such as elephant and gaur can be tracked down, but the bear is especially hard to see, for it lives largely in trees. It leaves few signs of his passage on the ground. Torn-out ant nests, ripped-up decayed logs, or claw marks on a tree may indicate that a bear has been around, but seldom indeed is the animal itself encountered in the forest.

To study the Malayan bear, then, one must keep it in captivity and yet allow it as much freedom as possible. Bertie came to us as a tiny, black, furry, helpless bundle, not more than two weeks old. One day soon after he was born, his mother wandered into an aboriginal cultivation to enjoy a feed of maize. Her depredations had barely begun, however, before she was seen by the aborigines. When they chased her out, she dropped in her haste this very tiny black cub, which was handed over to us the next day.

He took to bottle feeding with no trouble, and when he was hungry, there was no peace for anyone until he was fed. He was quite blind when we first got him, and he used to scramble about the floor complaining at the top of his voice, bumping into objects and roaring the louder each time he hit something. While sucking at the bottle, he produced sounds somewhat reminiscent of the noise ducks make while grubbing in shallow mud. The skin of his belly became as tight as a drum when he reached his capacity, and he would roll on his back and kick his legs about just as a baby does. He would suck his paw and play until he fell asleep—always on his belly, with his head tucked *under* both forepaws.

For some time, his bulging eyes had that bluish, opaque look sometimes seen in an old dog with failing vision. At the age of two months or so, however, he could gallop around without knocking things over or stubbing his nose on a table leg. We never knew when or at what intervals his teeth appeared, as he would not allow us to investigate.

When he was six months old, we took him to the King George V National Park, where we hoped that he would grow accustomed to the jungle, which was close by, so that he would in time return to it. The way was open for him to do so for eighteen months, but he did not take advantage of the opportunity and would be absent only for a few days at a time. Once he came back with one eye damaged, possibly by the barbed-wire fence surrounding the compound. It never recovered, and his vision remained impaired. He never used his eyesight much but depended on his ears and nose to tell him what was going on. When called by name, he would come from quite an amazing distance.

Definite Likes and Dislikes

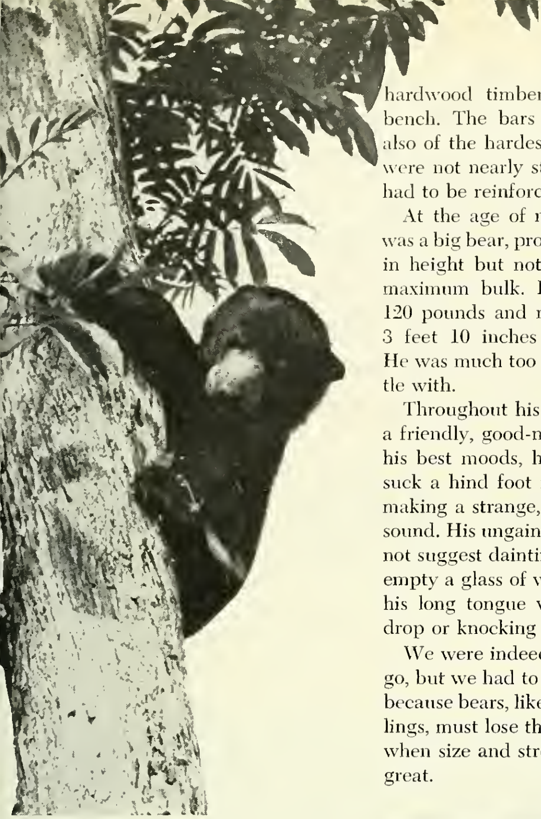
The more Bertie grew, the more handsome he became. The characteristic white U on his chest was extended at both ends to meet at a point under his chin. His coat was glossy black, his muzzle pale gray. He was extremely fond of bread with honey, syrup, or jam and would come to beg for it after his evening ant hunt in the garden. When he had licked all the honey off the bread, he would eat what remained by lying on his back and using all fours and teeth to grapple with the crusts. But when given a morsel he did not like, he would show his disapproval by clasping his forepaws over his ears and shaking his head violently with his chin close to his chest, while rolling upon the offending food with determination.

In the Park he took delight in climbing onto tree stumps and fallen logs, and he rapidly graduated to sturdy bushes and small trees. His favorite pastime before he discovered what ants meant to bears was to go to the top of a small tree, break off twigs and small branches, and form them into a sort of platform. We concluded that he may have been trying to build himself a sleeping platform.

On one of his tree-climbing exploits, he found a stream of black ants running along a branch. His long tongue played havoc with them, but in his excitement, he lost his balance and fell from his perch, sliding down the trunk with claws digging wildly into the bark. He hit the ground amid a cloud of dust and falling bark, with an audible bump that drove the breath completely out of his lungs. He was more careful thereafter.

Eventually he discovered that decayed tree stumps and logs contained many tasty forms of insect life, and his powerful claws would reduce everything to an untidy heap of debris. His jaws were immensely strong, and time after time they demolished the three-by-four-inch

◀ **Bertie** was bathed once or twice a week and was a pathetic sight when wet. A good rub-down and sunbath always brought him back to normal.



hardwood timber of his sleeping bench. The bars of his enclosure, also of the hardest possible timber, were not nearly strong enough and had to be reinforced with metal.

At the age of nearly two, Bertie was a big bear, probably fully grown in height but not yet filled out to maximum bulk. He weighed over 120 pounds and measured close to 3 feet 10 inches from tip to tip. He was much too powerful to wrestle with.

Throughout his captivity, he was a friendly, good-natured animal. In his best moods, he used to sit and suck a hind foot for hours on end, making a strange, happy, humming sound. His ungainly appearance did not suggest daintiness, but he could empty a glass of water or milk with his long tongue without spilling a drop or knocking the glass over.

We were indeed sorry to see him go, but we had to send him to a zoo because bears, like many other wildlings, must lose their human friends when size and strength become too great.

Description

In build and habits, the Malayan bear is rather similar to the Indian Black Bear but slightly smaller, with small rounded ears and a short, sleek coat. The characteristic U-shaped mark on the chest may be white, orange-yellow, or any shade between, and it may be flecked with black. The muzzle is gray-brown.

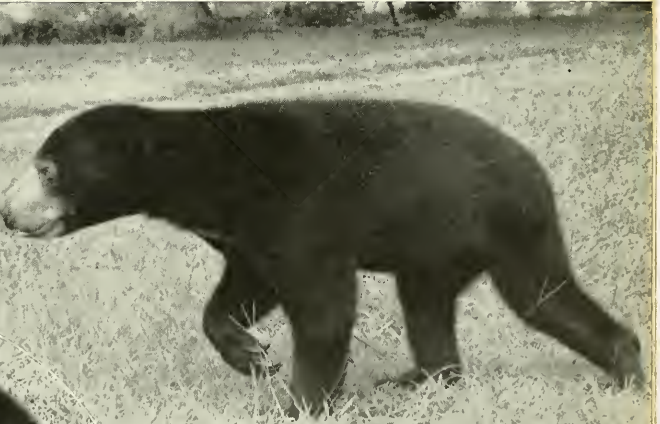
A fully grown male may measure up to 4 feet 6 inches or so from tip to tip and weigh as much as 150 to 200 pounds. The Malayan bear feeds on fruits, flowers, grubs, ants, termites, and honey, and does not shun carrion. Tracks are often seen on sand banks beside pools and rivers but there is no evidence that the animal fishes.

Several cubs may be born in a litter. There may be no regular breeding season, but cubs have been recorded on several occasions during August.

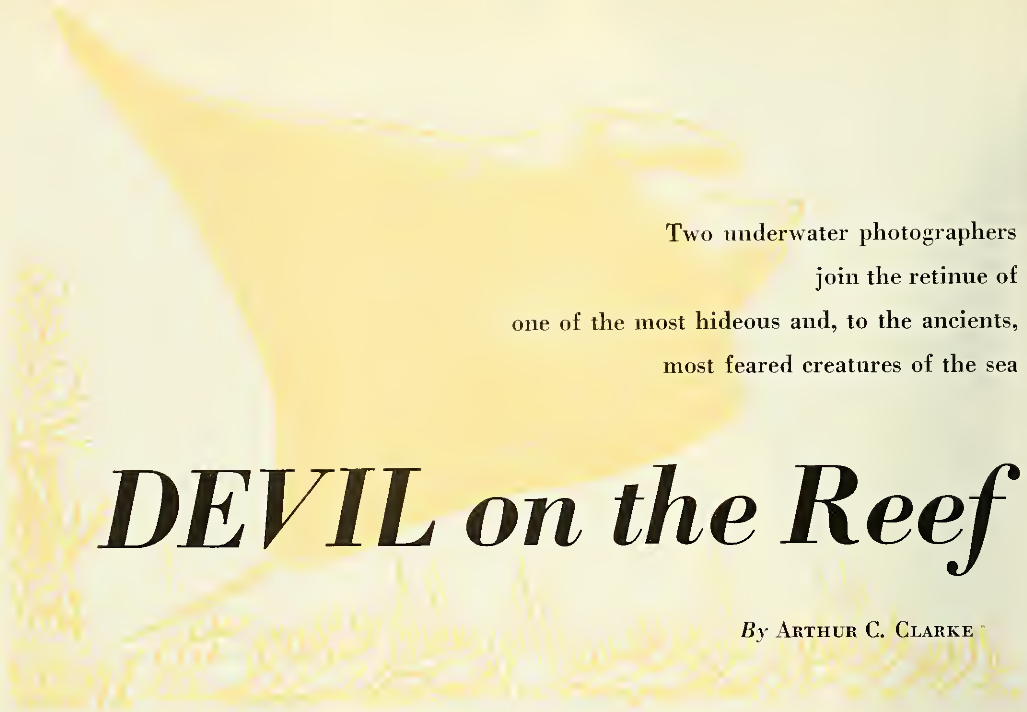
The range of the Malayan bear extends throughout the Malay peninsula and probably as far north as Assam.

▲ **Bertie** on an early tree-climbing expedition. Though given his liberty, he wouldn't take it.

▼ **He was extremely fond** of honey. If given food he didn't like, he would clasp his paws over his ears and shake his head violently.



▲ **Fully grown.** Note the smooth lines, sleek coat, and gray-brown muzzle.



Two underwater photographers
join the retinue of
one of the most hideous and, to the ancients,
most feared creatures of the sea

DEVIL on the Reef

By **Arthur C. Clarke**

THE underwater world of a coral reef is a place of perpetual change. Tide, wind, water clarity, cloud cover, elevation of the sun—all these factors are constantly altering, and with them the whole aspect of the world beneath the waves. It is a strange and wonderful sensation to be 20 or 30 feet down when the sun manages at last to break through a heavy blanket of clouds. At one moment you are floating in a somber blue mist, able to see only a few feet even if the water is at its clearest. You will feel depressed and a little apprehensive, for out of that closely encompassing blueness, anything may appear without a moment's warning. The slopes of broken coral beneath you will be drab and colorless, drenched in a twilight and autumnal gloom.

Then the clouds part, and the sun bursts forth. Though you can see neither sun nor cloud, everything around you is at once transformed. The coral hills and pinnacles become radiant with life; the constellations of tiny fish glitter as they turn in the slanting rays of the sunlight, which are now driving into the depths. Your horizon expands as if a fog had suddenly lifted; the dreary, monochrome gloom that had hemmed you in and oppressed you with its hidden menace now becomes a wide, enchanted vista glowing with soft colors so lovely that any thought of lurking danger vanishes at once.

This transformation is the most dramatic that the reef can know, for it can happen in a matter of seconds. But there is also something else that can alter the whole mood and aspect of the underwater scene. The reef, after all, is primarily a background, a living yet immobile stage against which the multitude of fishes act out their little lives. After a few visits one gets to know them all, not only as types but even as individuals. There is that mournful and aptly named pipefish, the perfect underwater equivalent of the dachshund. Circling a rock is the dignified batfish, which never strays far from its home and flaunts its brilliant colors as if certain that nothing in the sea will molest it. Down there in the shadows is a splendid 50-pound groper which suspects that you have designs on it and watches you with a wary eye; the white scar on its back shows that it has encountered man before.

These are the permanent residents, the actors who are always on stage. But ever and again there will come in from out of the ocean depths an intruder who does not belong here, an actor who dominates the scene so completely that all the other characters are forgotten. You may dive at the same spot a dozen times and meet exactly the same fishes, haunting the same places in the coral garden. And then, one day . . .

The tide was falling that morning when my partner and I rowed out over the flat fringe of dead coral and came to the living edge of the reef around Heron Island, in the Capricorn group of the Great Barrier Reef. Though there was some cloud, most of the time the sun was shining, and the water was wonderfully clear. There was hardly a trace of wind, and the surface of the sea was so still that for long intervals we could observe every detail of the coral-encrusted slopes 40 feet down.

We had chosen a favorite spot at which to dive—a fantastic grotto on the edge of really deep water. Our main object was to test the new Ektachrome 35 mm. color film we had just obtained from New York at vast trouble and expense. I had already mapped out a series of carefully planned shots, with and without flash, to discover just what this new film would do. Nothing must distract us from taking these test shots; on three earlier occasions we had been diverted, or conditions had been against us, but *this* time . . .

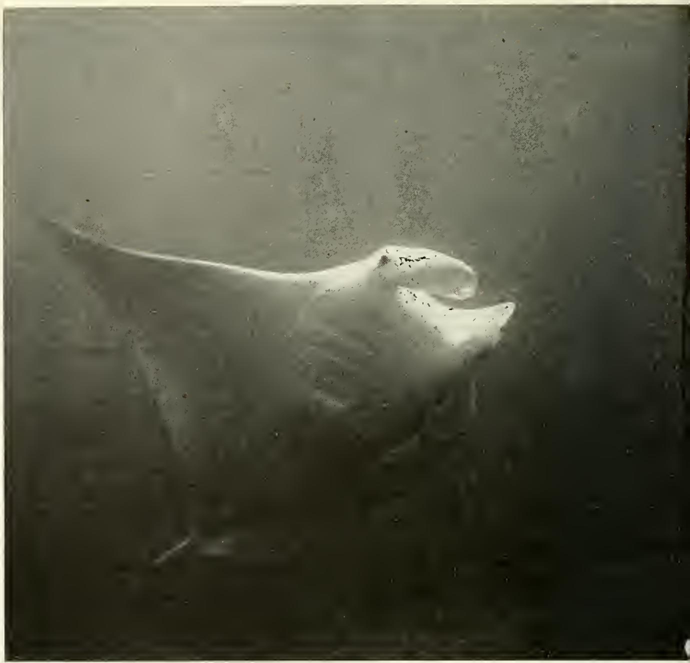
When we reached our selected site, such a powerful current was flowing that we decided to move on to quieter waters, by rowing farther around the reef. Mike took the oars, not trusting me with them, though I had expressed my willingness to try the experiment—like the man who wanted to find out if he could play the violin. While Mike provided the motive power and bemoaned again the fact that we had no outboard motor, I kept a careful watch, through the glass-bottomed box, on the undersea landscape that flowed slowly beneath us. We were moving above new and unexplored territory, and at any moment we might see some attractive coral vista that would demand to be photographed with all the different combinations of flash and filter we could muster.

The waterglass through which I was surveying the sea bed gave a rather restricted view, so I kept swinging it from side to side, scanning the zone over which we were passing. Although we had traveled no more than 100 yards from familiar territory, I had already seen several new types of fish, including one with a long pointed nose, which had obviously been designed for cruising at great speed. The scenery below us was not spectacular—an almost continuous thicket of stagshorn coral, with occasional patches of clear sand.

Through the surface of the water, distorted by a momentary ripple, I caught a glimpse of something large and white. I swung the viewing box toward it. For the first, and so far only, time in my life I was genuinely paralyzed with astonishment. There beneath us, looking quite as large as our dingy, was a magnificent manta ray. The gleam that had attracted my attention was the pallid white flesh on the inner side of the two "horns" extending ahead of the creature's mouth. It

▼ IT WAS ONCE THOUGHT that mantas could wrap their great wings around a swimmer and crush him.

was cruising very slowly in wide circles, its great triangular wings flapping lazily. A couple of pilot fish were keeping accurate station beneath its belly, mimicking every movement it made, while above it swam several smaller satellites. Indeed, it seemed to have almost as many hangers-on as a prize fighter.


▲ THE MANTA didn't even mind when a flash bulb exploded right in its face. When one swimmer came straight toward it, it swerved away.

I had seen many photographs of mantas, but it was quite a different matter to find one of these weird beasts swimming immediately below me, looking like nothing that had any right to exist in this world. To have come across it under conditions of such perfect visibility seemed too good to be true; very gently, without making a sound, we lowered the oars into the boat and gingerly let down the anchor. Gone were all thoughts of my carefully worked-out test exposures; we were desperately anxious to get some pictures—*any* pictures—of this splendid apparition before it took fright and vanished out to sea.

Moving with catlike caution, we put on our flippers and face masks, glancing over the side every few seconds to see if we still had company. There was no need to use the viewing box, for the manta's presence was immediately revealed by its startling white "horns," actually extensions of its fins. It continued its slow orbiting, each circuit taking it a little farther along the edge of the reef. Apparently it was feeding on the stream of plankton being swept along by the current.

With the camera round his neck, Mike slipped overboard and I followed a moment later, easing myself into the water so gently that I hardly made a ripple. Now we could see the manta clearly; indeed, we were two more parasites trying to join its retinue. Mike swam down to within five feet of it and shot a couple of pictures. The manta did not seem to mind in the least, even when a flash bulb exploded right in its face. We could not have hoped for a more tractable subject. It knew that we were there, for it kept a watchful eye on us, and once when Mike swam straight toward it, it deviated from its orbit just enough to avoid him. I have known *human* subjects who were much less co-operative.

When we had used half the roll of color film, I decided to switch to black-and-white as an insurance policy, and Mike climbed back into the boat to change the film. I was reluctant to miss any chance of observing this strange creature, which bore such an uncanny resemblance to a modern delta-winged bomber. The upper half of its body was a dark blue-black, but its underside was a ghostly white, broken by the parallel slits of its gill openings. Its back had been scarred by numerous scratches or lash marks, perhaps caused by the whiplike tails of its companions.

Mike handed the reloaded camera over the side, and I went into action again. We had brought one of our "Porpoise" compressed-air breathing units with us, and when Mike rejoined me in the water he had put this on in the hope that it would allow him more time to get into position for a real studio portrait. If you are free-diving down to 20 feet, you do not have a great deal of surplus breath, and there is time for no more than a couple of shots before you have to start climbing back for air.

"Keep away!"

It was now that we had our first momentary qualms about sharing the water with this large and powerful beast. Manta rays have a fondness for rubbing their horns against anchor lines or diver's hoses, just as a dog may scratch itself against a chair—and for much the same reason. The ocean has its fleas, or their equivalents. Unfortunately, this habit sometimes has disastrous consequences; mantas get entangled in moorings, become frightened, and may tow a small boat for miles. The results can be even more serious when a diver is involved, and there have been several deaths from this cause. This has not helped the manta's reputation, already somewhat damaged by its popular name of "devil ray."

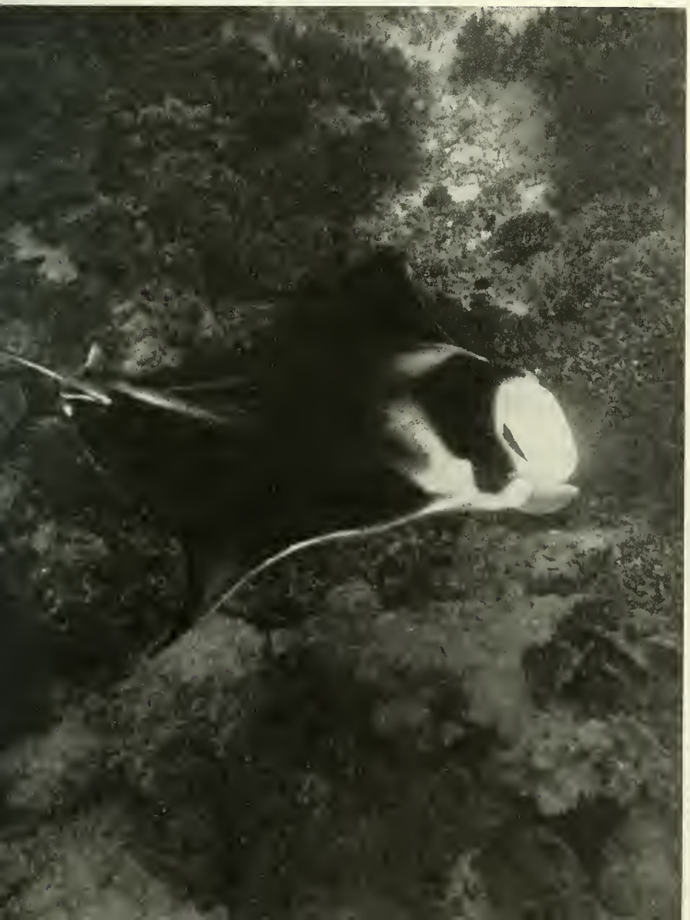
I became distinctly anxious when I noticed the manta showing a great curiosity in our anchor line. It would be a long swim back if we lost the dingy, though we had no objection to the ray rubbing itself on our property as long as it did not overdo matters. When it had got to within a yard or so of the line, however, the arrival of Mike made it abruptly change its mind.

Until now it had taken little notice of us; we were just a couple more hangers-on. But now Mike was emitting clouds of bubbles as the air gushed out of his "Porpoise" exhaust valve. The manta gave one look at him and reared up in the water exactly like a startled horse. It banked round in a great circle, its pilot fish scattering in confusion. Then it drove off downstream with powerful beats of its great black wings, and we knew that we would have no chance of catching it again.

Legend versus Fact

It did not matter; we had been luckier than we had any right to expect, and the final flurry of action had given us some dramatic pictures. We had been literally face to face with one of the most hideous and, to the ancients, most feared of all the creatures of the sea. At one time it was believed that manta rays would wrap their great wings around a man and crush him to death; today we know that for all their ugliness and unfortunate nickname, they are perfectly inoffensive beasts. They do not even possess the barbed spikes that make the sting rays, their smaller relatives, much more dangerous creatures to approach.

▼ LOOKING like a huge delta-winged bomber, the manta banked in a circle and drove off with powerful beats of its black wings.



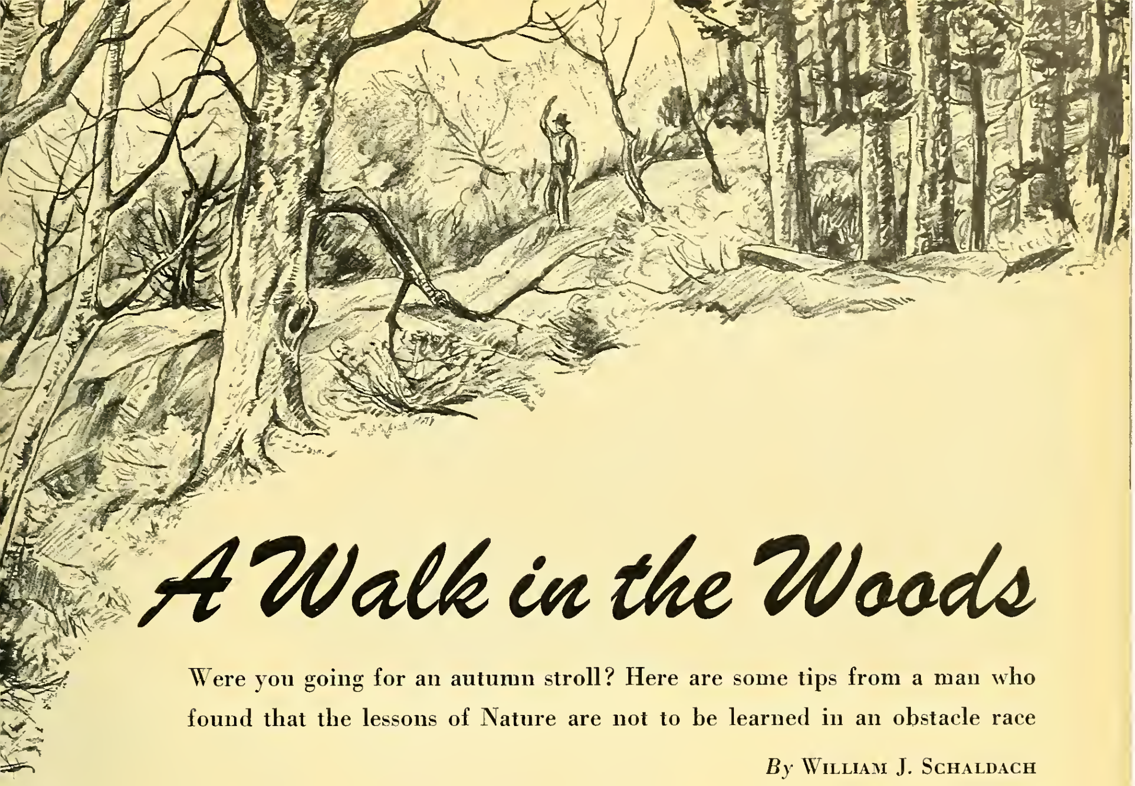
And is it really true to call the manta hideous? At first sight, perhaps, its appearance is diabolical, even terrifying. Yet it is doubtful if anything in Nature is really ugly. Ugliness, like beauty, exists only in the mind of the beholder; it is a purely human conception. At no time did I feel, as I was swimming around the manta, that there was anything repellent about its form. The animal seemed rather to possess the whimsical grotesqueness of a gargoyle. Indeed, as I grew to appreciate the grace of its movements and the fitness for purpose of its design, it began to acquire a starkly functional beauty.

Fishermen sometimes amuse themselves by spearing mantas and letting the terrified beasts tow their boats—often for miles—before they are exhausted. Why quite decent men will perpetrate on sea creatures atrocities they would instantly condemn if inflicted upon land animals (has anyone ever harpooned a horse to make it tow his car?) is a question less difficult to answer than it might first appear. Fish live in an alien element, and many of them have outlandish shapes. Therefore we feel none of the sympathy, none of the kinship, for them that often links us to the creatures of the land. Few of us ever overcome the reaction that classes anything strange as automatically dangerous.

Let us hope that we will not always retain this primitive attitude and will learn to base our judgments on something more than mere appearance. For one day, when the frontiers of space are down, we may meet creatures who are much more hideous than the manta—and much more intelligent than Man!

Batfish

.Schaldach



A Walk in the Woods

Were you going for an autumn stroll? Here are some tips from a man who found that the lessons of Nature are not to be learned in an obstacle race

By William J. Schaldach

EVER since a certain midautumn day more than a decade ago, I have entertained very definite views on the subject of hiking in the open. These came as the result of an invitation to join an acquaintance for a little stroll at his place in the New England hills. If there had been any doubt in my mind up to that time concerning the marvelous flexibilities of the English language, the term "little stroll" dispelled it forever.

He was the energetic type, as full of beans as a setter pup on a leash and just as impatient of restraint. He raved about the beauties of nature—the azure blue sky that one sees only in autumn; the stark, ghostly gray trunks of beech trees; coppery leaves blanketing the forest floor; and dozens of other enticing virtues of the fall countryside. A real outdoorsman, I thought, just the fellow to hike with.

We started out rather earlier than I would have cared to, considering that the sun was still below the rim of the hills. He plunged into the brush in high gear, and since he was running the party, I could only follow. The first "heat" ended at the top of a high ridge, almost a mile from our starting point. Blown and perspiring, I finally caught up with him and asked what the rush was.

"Let's get this over with," he panted. "Want to show you the old quarry and the hidden pond. Very interesting. Then beyond, there's a stand of virgin pines. Must be hundreds of years old. You'll like to see them. Come on, let's get going."

The stretch to the quarry lay over broken ground—an ancient moraine interspersed with marshy areas—and the going was pretty tough. I wanted to shout to him to slow down (he kept several hundred yards ahead), but my pride wouldn't let me. On this mad march I had caught glimpses of interesting things: a clump of fringed gentians, rare autumn wild flowers; some coral mushrooms growing out of an old stump; a belated veery, reluctant to leave its summer home. These were the things I wanted to see, but there was no time to stop.

The stone quarry, which we reached after another hour's grind, would have been well worth-while —I think. There was no chance to find out. We marched around the top once at a pace rather faster than the double-quick, while he explained in short, explosive sentences what had been mined there and who owned it. I thought I detected garnets protruding from one of the rock faces. It would have been fun to stop and investigate, but the hidden pond lay a couple of miles over the next ridge and apparently time was running out.

The next lap was a real ordeal. He found a huge swamp to plow through, and when we emerged at last, torn and lacerated by cat briers and berry brush, I felt as though I had been put through a meat grinder. My exuberant companion was as fresh as the morning dew. But there was the pond, and it was a little gem. Lunch and an hour's loaf in the midday sun would undoubtedly restore my dampened spirits. I sat down on a fallen tree trunk, reached in my pocket for a sandwich.

"Better not get comfortable there," the Iron Man mumbled through a mouthful of the sandwich he was already munching in a standing position. "You're all sweated up, and you'll take cold if you sit down. Besides, we've got to see those pines. They're about three miles through the woods west of here."

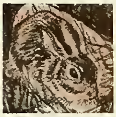
It it unnecessary to say that I didn't care for the pines when we finally got there. Nor was I impressed, that evening after the "stroll," by the jubilant announcement that we had done eighteen miles. "Just think of it, *eighteen miles!*" I was too busy thinking about the things we had missed and how some of them might have made fine memories for years to come.

There is no denying that exercise is beneficial to the body. Taken in sensible doses, it tones the muscles and strengthens the internal organs. And walking is certainly one of the finest forms of exercise. But the real benefit of locomotion afoot is only partly physical; its greatest value lies in the spiritual aspect.

Grind through milling throngs on city pavements, amid the roar of traffic and noxious exhaust fumes, for a distance of two miles and you will end up with burning feet and a wretched temper. Walk the same distance, calmly, peacefully, along a country road or through the woods and you will feel only pleasantly tired and in such a genial mood as to be prompted to up your Red Cross contributions. Why? Because in the first case you were all tied up in a knot and fighting something; in the second, you were relaxed and your mind was open to pleasant things. In each instance you covered the same amount of ground.

Do you recall the old oriental adage, "Tread softly, go far"? I have a hunch that by "far" the philosopher who coined that phrase meant something more than distance. It could be another way of saying, "Walk thoughtfully; what's the rush?"

In our mad pursuit of wealth, power, and fame we have forgotten the lesson taught by the ancients. Man springs from the earth and is a creature of earth. It is *right* that he should progress according to the unfolding concepts of his intellect but *wrong* ever to forget his origin. This, pathetically, he has done. He has erected monuments, edifices, and cities; developed transportation devices that eat up time and space; shackled millions in the chains of relentless business systems that carry on the process at an ever-accelerating pace. He destroys forests by greedy lumbering operations; causes erosion of vast areas of rich farmland in order to make a quick profit on crops; drains swamps and marshland that should be left as the breeding grounds of wild creatures. Man has become sophisticated and smart; but, on the whole, he has lost something very precious—wisdom. And until he rediscovers this virtue, he will seek in vain those lost things for which his nature yearns: inner calmness, tranquillity, spiritual peace.



These thoughts came to me as I reviewed the mad scramble I had taken with my impetuous companion on that November day. He had looked upon the woods and fields as an obstacle course, a problem to be tackled with a stop watch so that we might set some sort of record. He was a product of the times, professing to love nature yet ignoring her charms. It was merely word-of-mouth homage. I wanted sincerely to *live* that day and to have him live it, too; to grasp the meaning of midautumn's mood. The earth is somber then, readying for the long sleep. Not much is left of October's pageant of color—here a clump of orange-and-red wild cherry leaves; there festoons of gay bittersweet berries; again, branches heavy with scarlet black-alder fruit. But though "the tubes are twisted and dry," the late season is not barren.

November's woods can do something fine and inspiring to you and to me if we will only be unhurried and thoughtful. We shall not even have to try, if our mental attitude is right. The air is cool enough to be invigorating, yet there is still authority in the sun, and its mellow rays induce us to sit for long spells on fallen log or mossy rock to become unabashed loafers. Soon weariness of the spirit is shed and the calm mantle of peace descends upon us like a benediction. I have often wondered about the power of the outdoors to heal men's souls. Is it something deep and mystical? I think not. It is a natural and ever-present power, ready to help us. We have simply ignored it in our frantic efforts at overcivilizing ourselves. We have chosen false values and are in trouble. We can regain our perspective any time we choose by returning to the world to which we were born. As I ponder these things, I summon up again the scenes that the late-season offers, nature's invitation to contentment.

See now how vistas that were shut in by summer's greenery have magically opened. The hills and fields, even the forests seem larger, less restricted. It is a franker world, for there are no longer any secrets. In the clear atmosphere, far-distant hills rear their bulk sharply against the sky and seem only half as far away as they were in July. Mass has changed to line, and it is an etcher's world now, with branches and twigs, rock masses and the skeletons of goldenrod and joe-pye weed exactingly drawn. But color has not gone; rather it has grown grave and restrained. High-keyed, brilliant paintings are not always the most telling ones. What could

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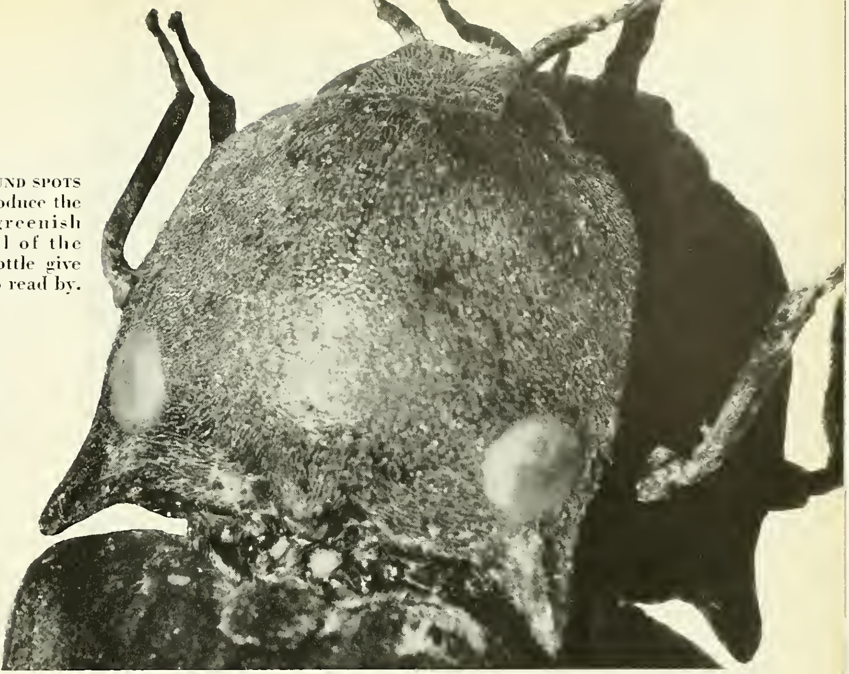


➤ THE TWO ROUND SPOTS visible here produce the continuous greenish light. Several of the beetles in a bottle give enough light to read by.

By

JOHN C. PALLISTER

Research Associate,
Department of Insects and Spiders,
American Museum of Natural History

Photographs by the author

Flying Saucers
OF THE INSECT WORLD

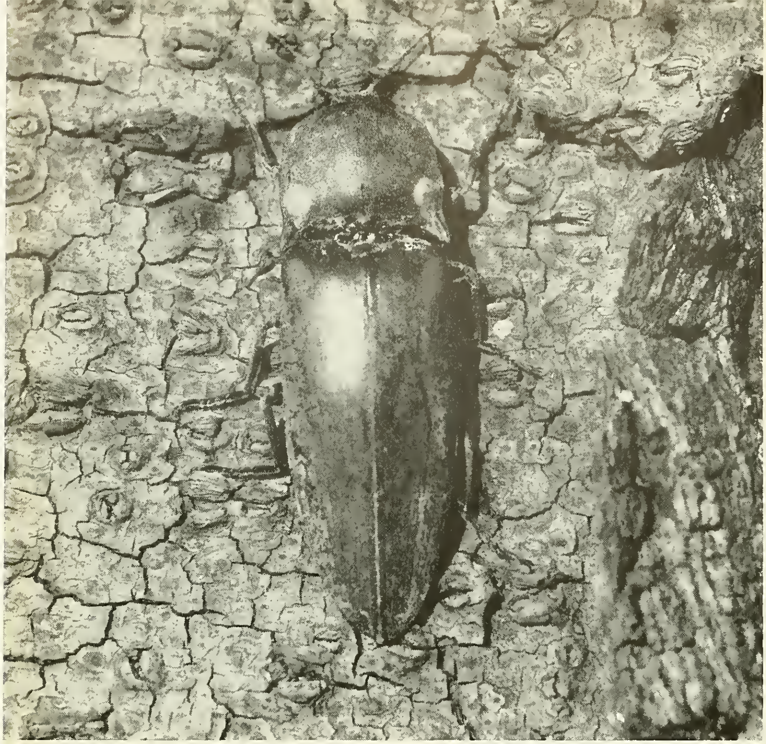
Golden balls of light that add beauty to the nighttime jungle and have many uses

MY first evening in Tingo María in eastern Peru's jungleland, I went hunting for night-flying insects. Around the village grew the tall, thick, humid forest, almost impenetrable except for numerous crisscrossing paths and occasional small clearings. I made for one of these clearings which I had spotted earlier in the day, where I hoped I could collect a number of strange new insects.

It was just at dusk, and I was readying my lamp, when suddenly a brilliant golden light came floating out of the treetops at one end of the clearing and crossed rapidly to the other, where it disappeared among the dense trees and vines. It was a breath-taking, almost shivery sight. It looked like a radiant orange disk or ball against the velvet darkness of the sky. In size and movement it was something like a helicopter's landing light, in color like a campfire seen through mist. A few minutes later, a second light sailed over my head, going in the same direction. By the time the third "flying saucer" appeared, I remembered what I had read and knew that these were luminous tropical beetles.

Of course I was unable to capture any of the ones that sailed so mysteriously 100 feet or so above my head; nor did any come to the Coleman lamp I had set up to attract specimens. After a few hours, with my bottles and boxes full of moths and other insects, I started back along the narrow trail toward Tingo María. I had not gone more than a few yards when I noticed a glow of soft greenish light on a tree trunk ahead of me, not more than three or four feet above the ground. As I came nearer, the glow began to separate into two spots. When I reached the tree, I did not need a flashlight to see the beetle. It was illuminated in considerable detail by the light from two small spots on its prothorax.

I picked the beetle off the trunk and examined it, the first of its kind I had ever caught. It looked not unlike the click beetles so common in my Ohio boyhood, to which it was related. It was nearly two



▲ A PYROPHORUS BEETLE is sometimes seen at evening, crawling up a tree from its daylight hiding place on the ground.

inches long, dull brown with fine black fuzz, rather narrow, and sleekly streamlined from a rounding head to a sharpish abdominal tip. And it had the same apparatus that would have sent it rocketing out of my hand into the air had I not been familiar with the click beetle's trick.

However, it had something that its Ohio cousins did not possess: light-producing structures. Indeed, it had a double set of them. There were the two green lights that had attracted my attention at first. But by lifting the insect's wings and examining its abdomen, I could see many small "windows" from which the insect could send a second light. This light would not be soft and green but the brilliant orange-red that had so amazed me a few hours earlier.

By the time I reached the hotel, I had three or four more fire beetles. To my "What are they?" the villagers replied *"Las cucujas."* This name, with some variations in spelling and pronunciation, is used throughout the tropical Americas for all the various species. In English they are "fire beetles" or "luminous elaters." In scientific terminology they are the genus *Pyrophorus* (meaning "fire-bearer") in the family Elateridae, the click beetles, or elaters (the latter a word familiar to crossword puzzle workers).

After a fire beetle has emerged from its pupa as a winged adult, it has only a brief period, at most a month, in which to illuminate its jungle, find a mate, and start another generation. It has passed the rest of its life of nearly one year, as in the case of all elaters, as a long, stiff, round grub called a "wireworm," living in old logs and decaying stumps upon which it feeds. All of these beetles are active only at night. Usually they leave the ground about dusk and return to the jungle floor for the daylight hours. The specimen I found low on a tree trunk may have just emerged from its pupa in the humus below, or it may have been late in starting its evening journey.

The light of *Pyrophorus* is practically cold, the same as that of our fireflies, and is produced in about the same way. The light is sometimes referred to as a phosphorescence, but this is in no way correct. It results from the oxidation of the compound luciferin in the presence of an enzyme-like material, luciferase. The reaction takes place in the cells of the luminous organs and requires the presence of oxygen and water. Unlike the interrupted or flashing signals of the fireflies, the light of the luminous elaters is continuous. Presumably the light is used as an attraction between the sexes.

Emergency Operating Lamp

Not all *Pyrophorus* species possess abdominal lights, but all carry the two thoracic lanterns. The brilliance and color of the light varies with the different species and also, probably, with the age of the individual. The intensity is incredible. Three or four of these beetles placed in a bottle will give enough light to read by. A familiar tale relates that at the time of the building of the Panama Canal, a surgeon in a small interior village performed an emergency operation by the light of a number of such bottles placed around the patient. Natives traveling at night fasten them around their ankles to light their pathway.

An early explorer, M. Michelet, wrote a delightful description: "In those countries one travels much by night to escape the heat. But one would not dare to plunge into the peopled shades of the deep forests if these insects did not reassure the traveler. He sees them shining afar off, dancing, twisting about; he sees them near at hand, on the bushes by his side; he takes them with him; he fixes them on his boots, so that they may show him his road and put to flight the serpents; but when the sun rises, gratefully and carefully he places them on a shrub, and restores them to their amorous occupations." He quotes an Indian admonition: "Carry away the firefly, but restore it from whence thou tookest it."

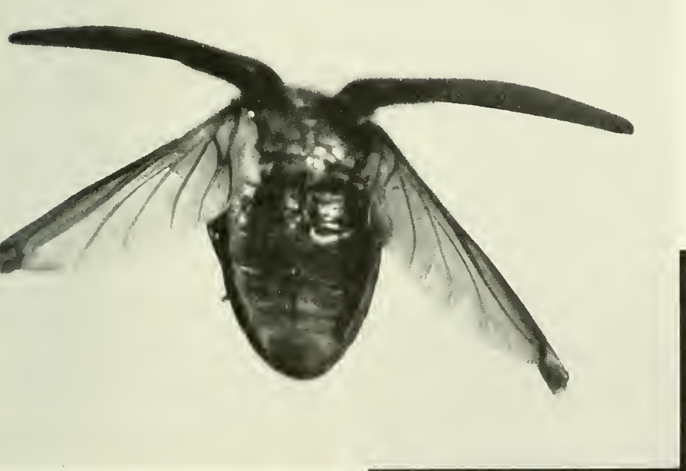
The native women at their village dances add glamour to their already colorful dresses by using these beetles as living jewels that sparkle without reflected light. They roll them in thin cloth, or fasten them by other means to their dresses or in their hair. It is said that when not in use, the beetles are kept in little cages and fed on fragments of sugar cane. Great care is taken of them; after the dance they are bathed in water to revive them before they are returned to their cages.

I was told that Indians collected fire beetles by waving flaming sticks to attract them. But I was never successful in having any come to my collecting lamps. In fact, I began to think that the light repelled rather than attracted them. Later, however, by directing the narrow beam of a strong electric flashlight on the beetle as it flew above the treetops, I was able to bring flying specimens down to within reach of my butterfly net.

I came upon this reaction by accident. Through simple childishness I pointed a flashlight at a beetle flying far above my head. This flashlight had a very strong, narrow beam. To my amazement, the beetle turned off its course and started to swing down, following a long spiral to the ground. I kept the beam on the beetle as well as I could while scrambling through the tangled vegetation to try to reach it with my net. By great good fortune I did capture this one. Many later attempts failed, for the beetles would plane downward with considerable speed, and I would have only a few seconds in which to reach for the insect with my net, endeavoring meanwhile to keep my footing and hold the beam on it. If a tree interrupted the beam, the beetle would resume its original direction and, to my great exasperation, disappear among the trees. This reaction distinctly shows that these luminous elaters are attracted by light if the beam is strong enough and continuous.

Pyrophorus has, so far, over 100 named species and a number of subspecies. All except two are found in the Western Hemisphere. Some are found as far north as Florida and Texas, some as far south as Argentina and Chile; but the greatest concentration of species is in Brazil, centering along the Amazon. There is a great field for further study on the classification and life histories of these beetles.

The awe-inspiring spectacle of flying *Pyrophorus* beetles is only one of the many exciting adventures possible to a field naturalist in the tropics.



▲ WITH THE WINGS SPREAD in flight, a continuous brilliant orange light is produced from luminous areas at the base of the abdomen.

➤ THERE ARE over 100 species of *Pyrophorus* beetles. The smallest are slightly less than one inch long, the largest over two inches.

▲ Portrait of a sand-hill crane at 61 days. The juvenile feathers of forehead and crown later disappear, and the top of the head becomes bare except for bristles. Few persons have had opportunity to see this bird at such close range. It is wary, and Wisconsin's total population went down to less than 50 birds not long ago.

Sand-hill Cranes
AT MY HEELS

The rising waters of a reservoir called for drastic changes in the lives of two rare birds and subjected the naturalist to heavy responsibilities

By Wallace Byron Grange*

Photographs by the author

STARS were shining, great horned owls were hooting, as I hid in the willows and alders of the point thrusting into the marsh. It was 4:21 and I was late; red-winged blackbirds were already singing. American bitterns made their pumping sounds: "Ka-kump-ump, ka-kump-ump." Marsh wrens sang. A greater yellowlegs fluted. From somewhere in the sky came the quavering winnow of a jack-snipe. I swept my binoculars over the brown marsh, which was now assuming a faint yellow tinge. There, looming up against the white wall of mist, were the three dead tamarack trees that marked the location of the nest. Through the glass, I searched the huge expanse of marsh around them, but I could see nothing. Of course, it was still quite dark.

From the low cliffs of woods hemming the marsh, the drumbeats of ruffed grouse rolled and echoed in the chilly stillness. A great blue heron flapped past, dis-

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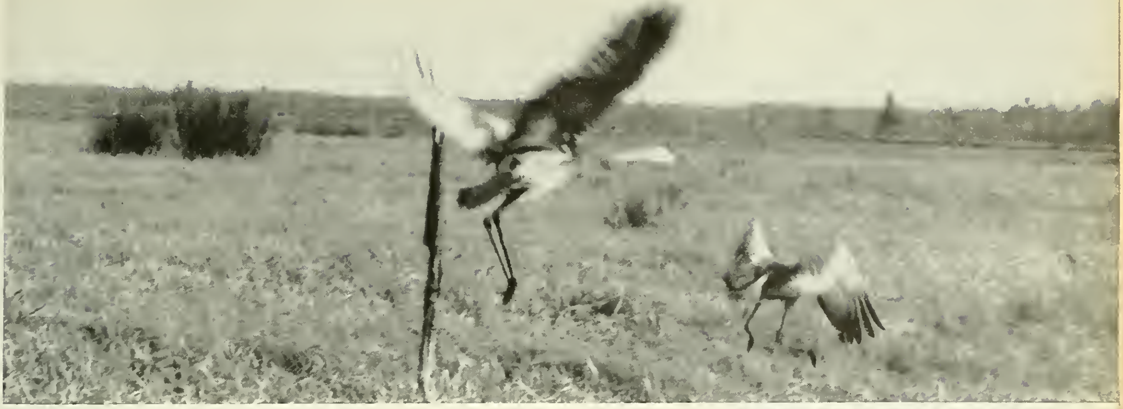
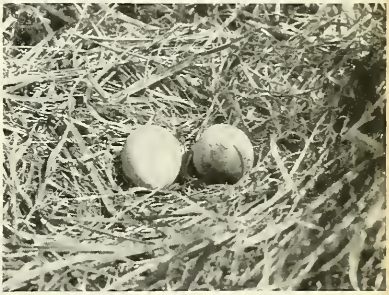
*Recipient of the coveted John Burroughs Medal this year for his book *Those of the Forest,* the author of this article deserves credit not only for his ability as a writer and naturalist but also for his determination in the face of discouragement. For the prize-winning book was "the stone that the builders rejected." Refused for commercial publication, it became just as much a home-grown product as the sand-hill cranes in this article. Mr. Grange and his wife undertook to print the book on their own and established The Flambeau Publishing Company to do so. They have had good success selling it; and Natural History feels honored to offer its readers the first article Mr. Grange has written since that brilliant work.—Ed.

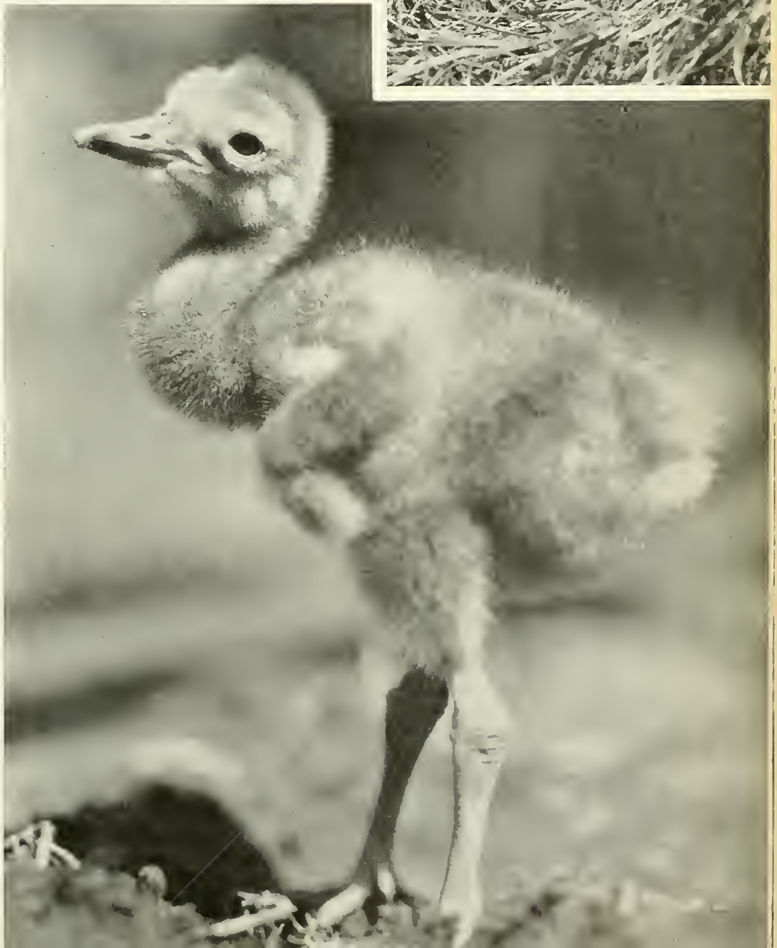


▲ **THE PARENTS**, photographed the day before the eggs were taken from the nest to save them from flooding. The forward bird, after running with beating wings, has just leapt into the air. The higher bird, already fully aloft, will shortly straighten out its "landing gear" beneath the tail.

➤ **THE TWO LARGE OLIVE-COLORED EGGS**, with lilac and deep brown blotches. Sand-hill cranes usually make their nests in water, but this one would have been drowned by the new reservoir.

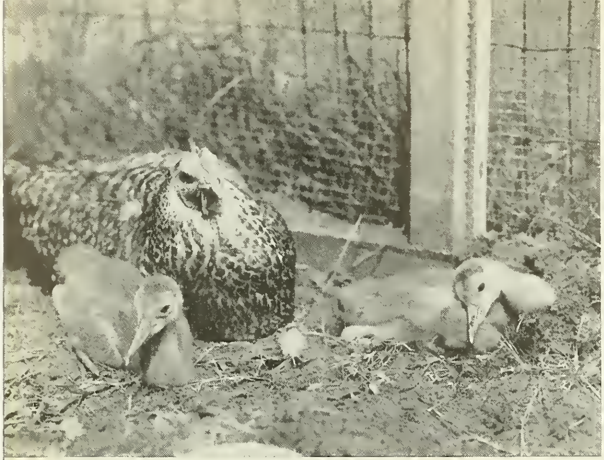


➤ **ONE OF THE YOUNG CRANES** on its fifth day of life. It is growing rapidly and has already gained much weight. The thick leg joints, short bill, and odd little wings are characteristic. At this age, young cranes are lively and are able to follow their parents through the marsh.

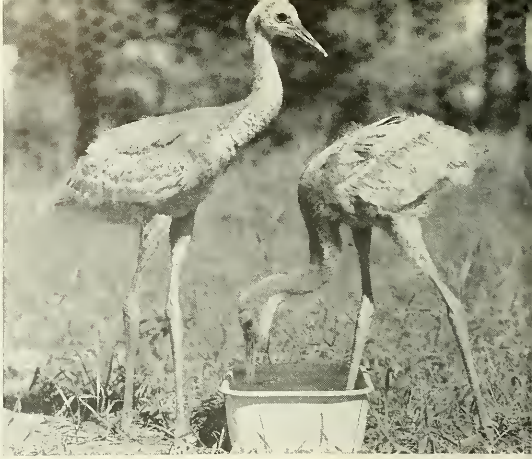


appeared in the mist. A fox barked. As light increased, I continued to listen and to search the grasses and sedges near the tamaracks. Many minutes passed and I saw nothing. I heard the first scarlet tanager and rose-breasted grosbeak songs of the year; the call of a crested flycatcher; the quacking of mallards. All of the characteristic sounds of May ninth in the interspersed marsh and woodland country of central Wisconsin seemed to be present—all except the ones I most wanted to hear: the throaty trumpeting of sand-hill cranes.

Cranes ordinarily call from or near the nest before sunrise. The absence of their calls seemed an ominous indication that something was wrong. A splash of green aspen leaves in woods that had been dark told me that if sand-hill cranes were



▲ THE HEN that brooded the eggs became a foster mother but had no talent in bill-feeding. The birds are now 11 or 12 days old. They frequently slept with the head slung onto the back as at right. They sometimes sat or stood under the hen's tail feathers.



▲ AT 37 and 38 days, Silver and Turk were nearly covered with feathers and had begun to look like adult sand-hill cranes.

present in this marsh I ought to see them; but there was no sign of them. As the rim of the sun came over the trees, I was greatly worried. Had I muffed the opportunity of a lifetime?

I thought of the many natural hazards that crane nests face, and of the abundant raccoons that prowl the marshlands seeking eggs and other choice foods. At dusk last evening I had verified the location of the nest. Two sand-hill cranes had leaped into the air near the dead tamaracks. They had flown low over the grasses, then alighted, scolding until the marsh rang with their cries. I had seen their nest, a mound of dried grasses and sedges, and in the shallow saucer of its top, two large olive-colored eggs with lilac and deep brown blotches. The eggs might easily have been destroyed during the night. If nest and eggs were safe, why should I not see the crane that was off duty? Why had they not called? Why had I not taken the eggs last evening, without waiting for further observations or photographs?

My mission was to save the eggs, for these cranes had nested in a cranberry reservoir held dry over winter but now being flooded. Their nest was doomed. At 5:30, dismal over my failure, I began slogging toward the dead tamaracks, although it seemed superfluous to verify the fact that the hay-mound nest was empty.

A scarce bird

With each step through wideleaf sedge and bluejoint grass, I sank into sphagnum moss, shallow water, and peat. Here and there were wild cranberries and pitcher plants. A century ago, this marsh was a tamarack forest, with openings where wild cranberries and pitcher plants must have been abundant. Today, tamaracks, wild cranberries, and pitcher plants are uncommon, even rare. In those days, there were no sand-hill cranes in this part of Wisconsin, for they lived then upon prairies to the southward. Now the prairies are gone, and of course their cranes, also. But as the central country was opened up and transformed by fire and by man, cranes invaded, and now this acquired range is their stronghold.

Even fifteen years ago, Wisconsin's sand-hill cranes appeared doomed to extinction, for fewer than 50 survived. Recently, for unknown reasons (for the increase extends to other regions as well), cranes have increased to more than 200. This is unquestionably due in part to the creation of numerous shallow impoundments in central Wisconsin, which have expanded the marsh type of habitat. Cranes are exacting in their environmental requirements. They must have open country, now commonly consisting of huge marshes or of smaller ones in series; and they require pools or ponds, and some upland habitat as well. These conditions are met in Wisconsin today only where such favorable land uses as cranberry culture occur, or where man has not yet come to claim wild marshlands for the plow or for livestock. Landscape and vegetation change rapidly with settlement, and our expanding population is making greater and greater demands on formerly wild country. We may well ask what will happen if our organic marsh soils become needed for standard crops? Will there still be homes for sand-hill cranes?

At 300 feet from the tamarack skeletons, there was still no sight or sound of cranes. Nor at 200 feet. Nor at 100. "No doubt about it," I thought, "Something got those eggs!"

But I slogged on. At 75 feet, there was a sudden great flapping of huge wings as a gray sand-hill jumped, leaped, and bobbed through the grasses, half-flying and

▼ NOT AN OSTRICH OR A HERON but a 41-day-old sand-hill crane resting on its hocks to take the sun.

▲ AT 59 days, Silver flew 10 feet. Here at 61 days she is running with outspread wings in an experimental flying maneuver.

silent. It alighted 200 feet away, then commenced running with wings outstretched conspicuously, no doubt inviting pursuit. "The eggs are safe!" I thought, and without approaching the nest, I turned back.

The gray crane now became noisy. Just after I gained the willows, its mate, a brown-colored crane, flew silently into the marsh from low over the woods. Immediately, the two tall birds began walking about tensely, side by side, heads and necks held stiffly in an angular forward-thrust position, calling in unison. These were alarm calls, deep-toned but with a creaky or rattling quality. Crane trumpeting, too, which is somewhat lower in pitch, contains this rattling element when heard close at hand; but at a little distance all sand-hill crane sounds impress me as being melodious, for the creaking drops out. Crane music stamps a country with a characteristic primeval wildness, adding something that I should miss greatly if I could not hear it each spring.

As I watched, hidden in the thicket, the birds became quiet. The gray crane walked about alone, head still thrust forward, scrutinizing the marsh and woods intently. Meanwhile the brown crane stood erect, motionless, watching also. After some moments, the brown bird relaxed, then walked sedately and slowly toward the dead tamaracks. It stopped, thrust its head down into the grass, raised it and lowered it again, then settled out of sight on the nest. The gray crane then flew silently from the marsh, over the trees. The two had exchanged turns incubating their eggs. I had seen the changing of the guard.

Later, I returned to the nest with a camera and a substantial box. The brown crane flushed at 200 feet, calling; and soon its mate flew into the marsh. Both were frenzied in their attempt to attract me from the nest, but they stayed a cautious distance away.

This caution is typical of sand-hill cranes. Although their powerful voices advertise their presence to those who recognize them, they are exceedingly wary during the nesting season and are skillful in keep-

▲ TURK AND SILVER had nearly complete juvenile plumage at 65 days. Note the prominent nostril opening.

▲ COMING HOME in close formation after a flight around the Corner Marsh.

ing out of sight. Often they select marshes that provide concealing screens of willows or trees or are remote and inaccessible. One can scarcely believe that such large birds, standing three feet tall and having a wingspread of five feet, can so successfully elude observation even when their nesting marsh is known. Cranes are conspicuous when walking about in open grass, and they survive through alertness, caution, and the protection afforded by difficult wild country, as well as because of protective laws and suitable migrational and wintering refuges. They prefer wilderness, yet they tolerate man, if he does not persecute them or come too close and if there is suitable marshland.

After securing photographs, I placed each egg inside a heavy glove, wrapped them in woolen cloth, and put them inside my box.

As I left the marsh, the cries of the cranes were ringing painfully in my ears. I was a thief. They knew it, and I knew it. I think I understood correctly how the two cranes felt. To them I was a mortal enemy. They could not know that my motives were friendly. They could not know that the distant sound of running water meant the flooding of their nest, the doom of their eggs. I felt a deep sympathy for the cranes, and a great responsibility for the custody of their two eggs, but unfortunately one cannot convey such ideas to wild creatures.

At the car, I filled a hot water bottle from a vacuum jug and placed it inside the box to maintain warmth. After a 40-mile auto trip, the two crane eggs were placed beneath domestic hens incubating duck eggs.

Successfully hatched

So, on May 18, I held the first very reddish, heavily-downed (I almost said "furred") crane in my hand. It was about five inches high, standing up. Its bill, feet, and legs were pinkish and swollen (which is normal); the "knees" seemed enormous. It could walk about, but it was very wobbly. It fell, cheeped, and preferred to remain still. Its first food was a bit of hard-boiled egg, which it did not like; then a house fly, and a small bug, and nearly an ounce of chopped raw beef. When I placed the sand-hill beneath a heat lamp, it cheeped plaintively, not for lack of warmth, or from too much, but apparently from loneliness, for the instant I took it into my hand again it slept contentedly.

The second crane hatched on May 19. I brought them home with the hen, made a pen indoors, and slept near it. I watched over them day and night, pondering my responsibilities, for after all I did not know their language, or they mine, and there were difficulties to be overcome. My work suffered serious neglect, but what did that matter—I had two sand-hill cranes!

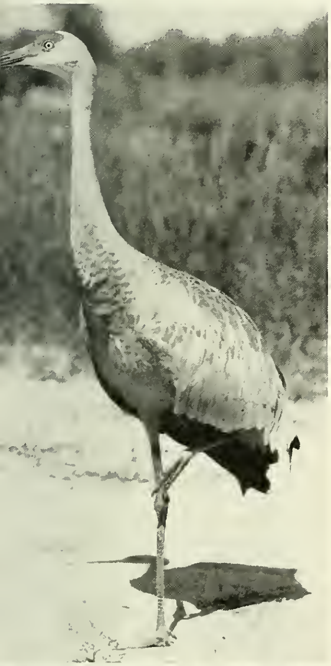
Until the ninth day, Turk and Silver (as they were eventually named) did not learn the significance of the "farm yard" hen's clucking calls. They refused to pick food up from the ground. Young cranes are fed from the bills of the adults, a technique the foster mother did not understand very well. I bridged the difficulty by hand-feeding every morsel, but at first it was not easy to get them started eating. Their attention seemed to wander, and I could not direct it. When they saw a fly or angleworm particle held out for them and attempted to peck, their aim was extremely inaccurate; they frequently missed the target several times before succeeding.

They were attracted to things of red, which may be a clue to the usefulness of the bare and very brilliant red forehead-crown patch of mature sand-hill cranes. It may serve to attract the attention of very young cranes to the parent's head and bill. But it is also very beautiful, and perhaps its ornamental value leaves no need for further explanation.

At two days of age, now less wobbly, but nevertheless a little unsteady on their feet, Turk and Silver not only ran and jumped but began to dance and to fight. Their dancing was typically juvenile; leaping up, bouncing, skipping. The fighting was savage. The two cranes stood high, face to face, then rushed, pecked, kicked, and cheeped—and pulled. Usually Silver, the first-hatched and slightly the larger, sent Turk sprawling on his back. Sometimes it was the other way round. Neither one was hurt in these combats, but since I forcibly separated them on several occasions, I cannot say that no damage would have occurred; nor would I discount the possibility of accidental drowning or other disaster in the wild resulting from it. Later, when Turk and Silver were fully feathered, I saw them fight only twice. Both combats were vicious. Each crane would leap above the other and strike with its feet, sending its adversary sprawling. They seemed evenly matched. Aside from these sudden fights, which ended with equal abruptness, Turk and Silver were not only friendly but inseparable. The significance and importance of early fighting (which is far too rough to be called play) is an unknown part of sand-hill crane life history. Their dancing soon developed to the point that whenever I approached their pen, they would come skipping, leaping, and flapping their wings, to meet me.

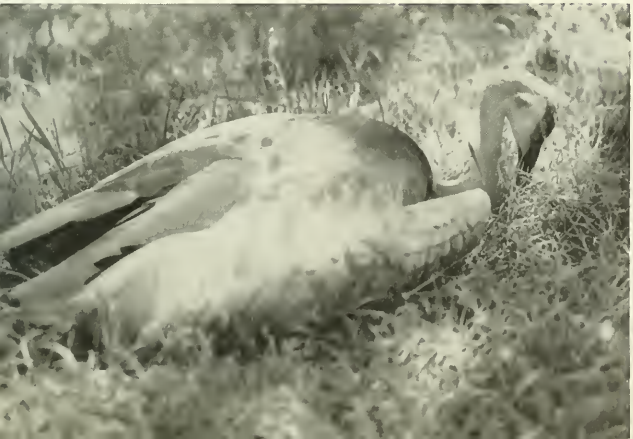
Turk and Silver grew so prodigiously that sometimes I thought I could see the difference from hour to hour. It was very evident from day to day. They thrived on a special diet of crayfish eggs and meat, frog muscle and liver, chopped minnows, raw beef, insects, eggshell, occasional rolled oats, worms, canned peas, canned corn, and canned apricots. Small moths in the grass, and later grasshoppers, were favorite foods as the birds grew older, and then came corn, wheat, and wild rice.

The cranes were much attached both to me and to the hen. I was always immensely pleased when they chose to tag along at my heels rather than to follow her. Their need for the hen rapidly diminished. Even at first, they had encountered some difficulty in finding enough room beneath her when being brooded. As they grew larger, they deserted breast and wing feathers to stand or sit entirely concealed in the feathers of and around the tail. Then even this became unnecessary, and they sat close to the hen simply for companionship. At



◄ **Silver** in adult plumage. showing the bare crown and forehead area. The primary feathers are remnants of the juvenile plumage that are retained for more than two years.

➤ **Silver scratching:** A study in balance and articulation.



◄ **Silver** in "invitational" pose. This posture is believed to signify readiness for mating and is the basis on which Silver is judged to be a female.

five weeks, when the cranes were nearly two feet tall, I took the hen away.

We had already formed the habit of going for walks daily. Turk and Silver looked forward to these as much as I did, and if our walk was postponed or delayed, they would become nervously impatient, pacing about, cheeping. Sometimes we would go to the field, hunting grasshoppers. They had outgrown the water dish in which they had formerly bathed, so we often went to the marsh, where they splashed and bathed with a great commotion of beating wings and rapid dipping of heads.

Spreading their Wings

As summer progressed, pinfeathers poked through the fading and now buffy rather than reddish down; then the tips of the pinfeathers burst and real feathers began to emerge, unfolding like little fans or opening flowers. Eventually, the bluish, basal sheath enveloping the shaft of each feather was shed, as was also much of the down the feathers replaced. As the long flight feathers of the wings grew and began to harden, Turk and Silver began to try their wings, standing on tiptoe while flapping them. At 59 days, Silver flew ten feet. Each day thereafter, trying to fly was a part of our daily regimen. The most I could do to assist was to run rapidly away, both cranes following, taking to their wings to keep up. I was proud of them when they flew 50 feet, then 100. It was not long before they flew the quarter mile length of the field.

As we explored marsh borders, I was at some loss to know what any of us ought to find by probing and digging in the mud, which Turk and Silver enjoyed. In fact, I have not yet found out even from observing wild cranes and then searching an inch or two beneath the surface of the wet peat where they were digging. So far as I know, Turk and Silver never found anything of edible value, but their probing was endless. I had the feeling that probing was instinctive, but that, deprived of their rightful training, they did not know what to probe *for*; or perhaps *where*. I am convinced that sand-hill cranes have a great body of tradition, which I would define as *learned habits handed down to succeeding generations,* from old to young. Since I was unfamiliar with crane traditions, I often felt keenly that Turk and Silver were not being properly educated.

On our walks there were blueberries, dewberries, and blackberries, and later acorns and hazelnuts. I picked most of the berries and handed them to the cranes, but they learned eventually to pick blackberries for themselves. However, they disliked to enter brambles and were reluctant to enter woods unless I coaxed them. Neither bird ever learned to crack acorns or hazelnuts, but they closely watched me as I did it and would eat the nutmeats as quickly as I produced them. Once Silver ate a small snake. It disappeared so quickly that I could not be sure, but I think it was a garter snake.

In late summer, grasshopper hunting was their favorite pastime, and this was the one prey that they systematically stalked, heads down in the grass, peering this way and that as they hunted. They but rarely chased grasshoppers; they secured them where they rested upon blades of grass, by a quick dart of head and bill.

Deprived of wild companions, Turk and Silver accepted people, almost as dogs do. Cranes apparently mate for life and are devoted family birds. They greatly enjoy companionship, and outside the nesting season commonly gather and feed in groups or flocks.

Silver acquired the nickname "Straw Boss," because she seemed to superintend every outdoor human activity, whether ditch-digging or nailing something together. She gravitated to such proceedings, sometimes merely watching, sometimes flapping wings, sometimes pecking at shiny objects such as nails, tinfoil, rings, or spectacles. She broke my metal wrist watch

continued on page 448

The little animal
has been given
a rough time
in front of the
movie cameras.
Few realize how badly
he has
been miscast

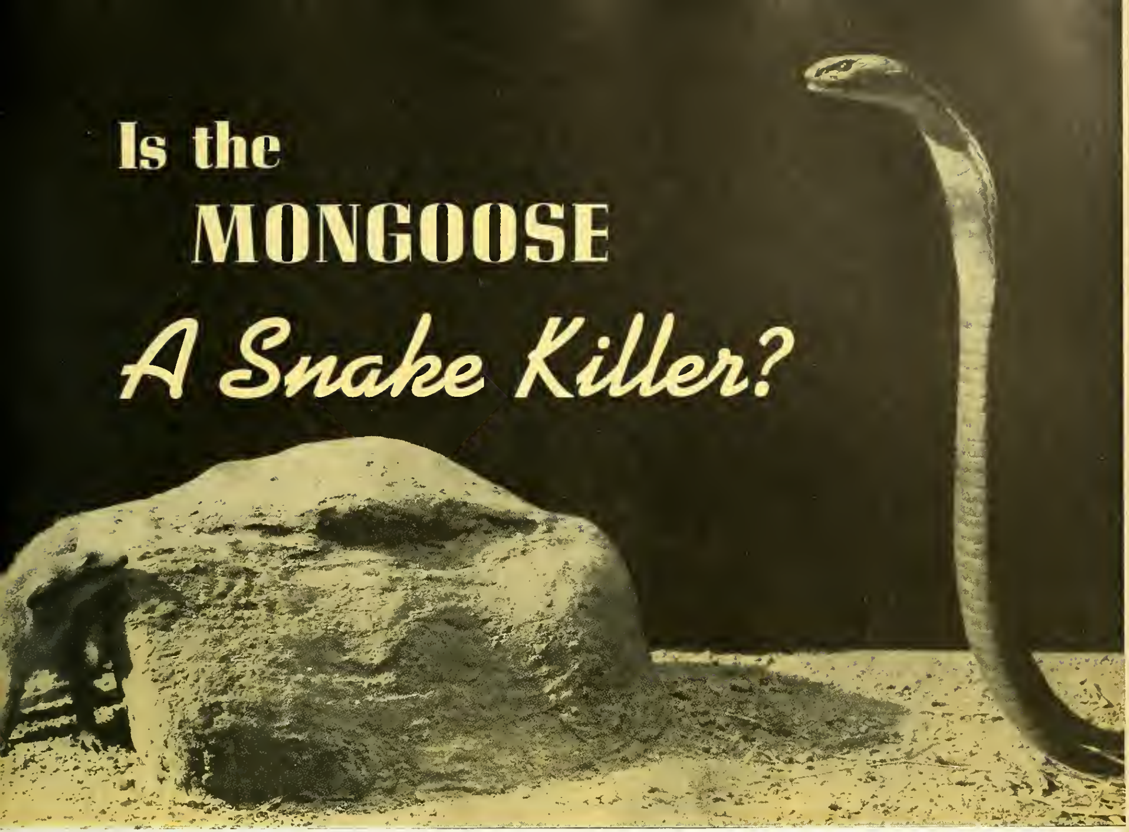
By
JAMES A. OLIVER
Curator of Reptiles
New York Zoological Society

YOU can credit the wonderfully versatile Rudyard Kipling with the mongoose's worldwide preeminence as a snake killer. In real life, Rikki-Tikki-Tavi doesn't deserve the reputation he has been given.

Let's look at the facts.

The mongooses (not "mongeese") are small weasel-like mammals related to the civets and genets of the Old World and belonging to the family Viverridae of Africa, Asia, and southwestern Europe. Many different kinds of mongooses are known in these countries. All are voracious and usually vicious predators, but some can be tamed as docile and dependable pets. In the wild they feed on all manner of small animal life—grasshoppers, crabs, frogs, lizards, snakes, nesting birds, rats, mice, and the like. When we use the term "mongoose" without further specification, the small Asiatic species, *Herpestes auropunctatus,* is the form referred to, for it is the familiar one of the Kipling story. This animal is also known as the

Is the MONGOOSE A Snake Killer?



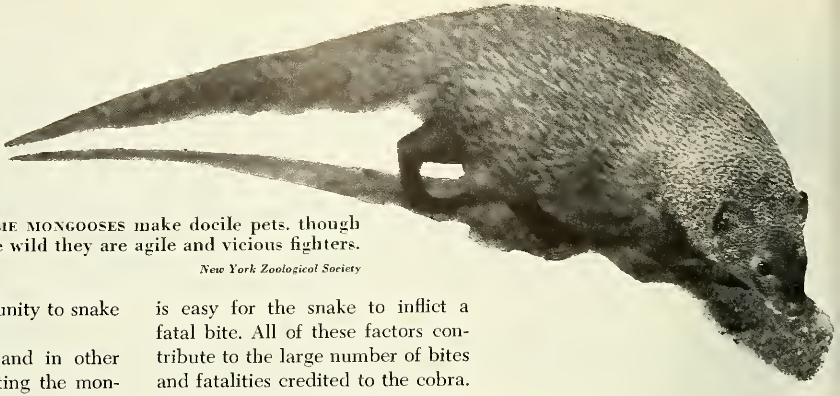
From a habitat group in the American Museum

Javan Gold-spotted, Gold-speckled, or Small Indian Mongoose. But it is more frequently referred to simply as "the mongoose."

The mongoose has been introduced in many of the warmer parts of the world, primarily to aid in the control of rats. "BK"—Before Kipling—it was never particularly thought of as a snake killer. Like most voracious predators, it will attack and eat almost any palatable animal that it encounters and can overpower. The most abundant animal and the one easiest to catch will generally be consumed in the greatest quantity. Hence, where rats are exceedingly abundant, the mongoose may perform a real service in destroying them. Naturally, it kills to eat, and not primarily for man's benefit. But—and this is a large "but"—what do you do with the mongooses when the rats are gone or reduced to the point where other animals are easier for the mongoose to catch? Also, what if the mongooses like to eat some other animal more than the one that we want destroyed?

These, of course, are fundamental problems in any wildlife control project involving the use of predators. They are the reason why the use of the mongoose has usually proved to be a mixed blessing at best. As a famous example, it was introduced into the West Indies in 1872 to aid in the control of rats on sugar plantations. Some benefit resulted, and its success stimulated planters in the Hawaiian Islands to import mongooses in 1883. After the expected initial benefits had been achieved, numerous complaints began to be made about depredations on poultry and native birds, particularly ground-nesting species. The rats were never completely destroyed, although they were reduced in some areas. Unfortunately, some species of birds were seriously reduced in population or were actually exterminated in both the West Indies and the Hawaiian Islands.

Well, how about snakes? When a hungry mongoose is hunting and encounters a snake it can overpower, it does not pass up any meal. If the snake is too large or too dangerous, the mongoose will avoid a fight; it seldom attacks snakes big enough to cause trouble. If a snake attacks the mongoose, it relies upon its own speed and agility for defense or escape. Its sharp teeth are effective offensive weapons, and its raised fur misleads the snake as to the size of its target. Small or sluggish snakes give the mongoose no trouble, but in encounters with large snakes or those that strike fast, the mongoose is likely to come out second best. Incidentally, it



➤ SOME MONGOOSES make docile pets, though in the wild they are agile and vicious fighters.

New York Zoological Society

does not possess immunity to snake venom.

In Kipling's story and in other familiar tales celebrating the mongoose's prowess, the snake is the Asiatic Cobra. This seems to enhance the mongoose's stature as a snake killer because the cobra is a widely feared, awesome-looking venomous reptile. It is true that the cobra is powerfully venomous and that it is responsible for a great number of human deaths annually. But, as snakes go, it is actually poorly equipped for using its venom effectively, and it is relatively slow in striking. The mongoose's credit is more fancied than real.

The cobra's fangs, like those of all the dangerous venomous snakes, are located in the front of the upper jaw. These large tubular teeth are relatively short and are immovably situated in the mouth. With this type of tooth structure the cobra has to bite and chew or scratch the victim. When striking, the mouth is opened only about 45 degrees. Thus both its method of striking and the nature of its venom apparatus are not adapted for quick injection of the venom and retraction of the head and body. I have seen a cobra strike at an inflated ballon four or five times before breaking it.

This is not to say that the cobra is a snake not to be respected, either by mongooses or human beings. It does possess a powerful venom, affecting primarily the nervous system. It occurs in fair numbers in an area of dense human habitation, where religious beliefs protect it from destruction by a large segment of the population. Most of the people wear neither shoes nor long trousers, so that it is easy for the snake to inflict a fatal bite. All of these factors contribute to the large number of bites and fatalities credited to the cobra.

The characteristic defensive posture of the snake is with its hood spread and with the forward one-sixth to one-third of its body raised vertically. From this position it strikes downward and forward for a distance a little greater than the length by which the body is raised from the ground. The strike is only about a sixth as fast as that of a North American Rattlesnake. I know one reptile keeper in an American zoo who cures his newly received cobras of the habit of striking by hitting them with his hand on top of their heads when they lunge at him. This is not a recommended treatment but does indicate the relative slowness of the cobra's strike.

Not habitual enemies

Any normally active mongoose can sidestep the strike of a cobra and can seize plenty of chances to sink its teeth into the snake's neck. But why do it when there is so much easier game? Despite the mongoose's admitted physical advantage over the Asiatic Cobra, there are few authentic reports of fights between the two in the wild, and in those parts of India where both snake and mammal are common, they apparently pay little attention to each other.

Because of the reputation that Kipling gave the mongoose, many fights have been staged between cobras and mongooses in captivity, often for the purpose of obtaining pictures to further the little mammal's prestige. Usually the sponsors of such contests are disappointed at the reluctance with which the two join battle. Often the principals have to be goaded into action, and even in such staged fights the mongoose is not always the winner.

Dr. P. E. P. Deraniyagala of Ceylon once staged a fight between a large cobra and a mongoose in order to observe exactly what takes place. He put the two animals in a wire enclosure. The cobra took a central position, with hood spread and body partly raised, and lashed out savagely whenever the mongoose came within range. For the first fifteen minutes, the mongoose made no attack and simply tried to escape. Finally it closed with the snake, and the fight was waged with fury. Once both were on the ground, rolling over and over. The fight was stopped after 50 minutes, when both animals were in a state of extreme exhaustion. Dr. Deraniyagala believed the cobra would have been killed if the fight had continued. But it was evident that "Rikki" did not go out of his way to pick a fight.

On the basis of the available evidence, the mongoose unquestionably is sometimes able to kill venomous cobras, but if it were really the snake killer of legend, the cobra would have long been exterminated in southeastern Asia. I know of at least one report from India of a mongoose and a cobra being both found dead, locked in mortal combat.

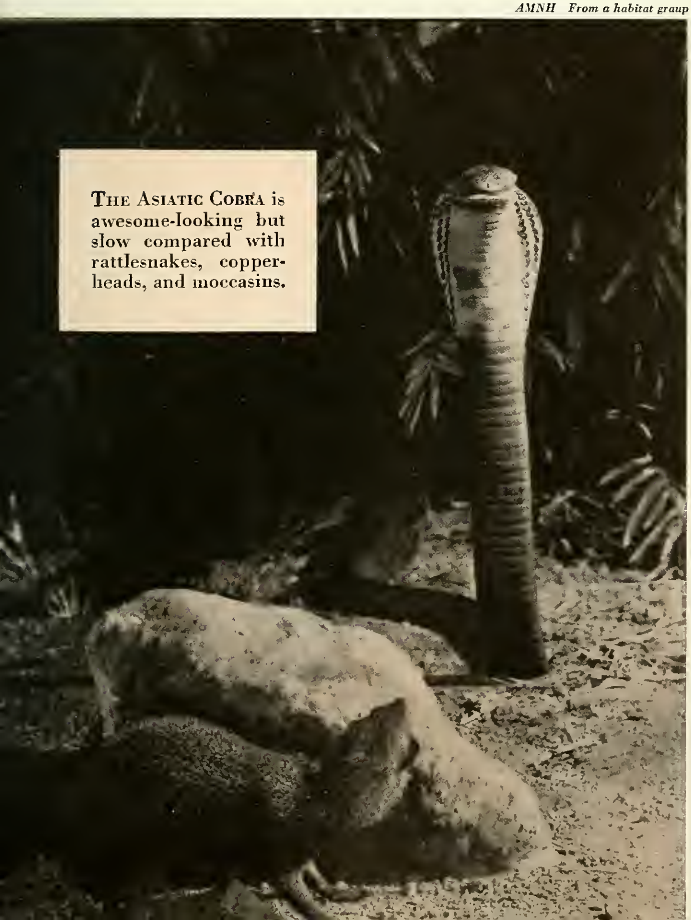
One of the West Indian Islands on which the mongoose has been introduced is Trinidad. Here the two most important venomous snakes are the fer-de-lance and the bushmaster, which possess long fangs that are movably attached to the mouth. When at rest these fangs lie folded back along the roof of the mouth, but in a strike they are raised about 90 degrees, and the mouth is opened nearly 180 degrees so that the fangs point out toward the victim. Typically, these snakes coil and draw the forward part of the body into an S-loop, so that in a strike the head is plunged forward with considerable force and speed, with the fangs stabbing into the victim. All of the pit vipers, including the rattlesnakes, copperheads, and cottonmouth moccasins, and the true vipers strike in this fashion and possess similar movable fangs. With such speed and fang equipment, these snakes are much more effective against the mongoose than is the cobra.

Less formidable prey

A hungry mongoose may kill and eat small individuals of these species, but data on its food habits indicate that this is a very rare occurrence. Dr. C. B. Williams studied the food of 180 mongooses collected in Trinidad. In not a single stomach did he find remains of a venomous snake. Those 180 mongooses had eaten 28 rats, 26 small birds, 18 snakes, 17 lizards, 29 frogs, more than 600 insects, 44 spiders and 3 crabs. The 18 snakes were all small harmless species.

Actually, on the island of Trinidad, snakes serve the purpose of keeping the mongooses from becoming overly abundant. Several species of boas feed on them. In a zoo cage, boas may appear sluggish, but in reality they are powerful constrictors that strike quickly from a position similar to that of the pit vipers and quickly subdue their victims in powerful coils of the body.

AMNH *From a habitat group*



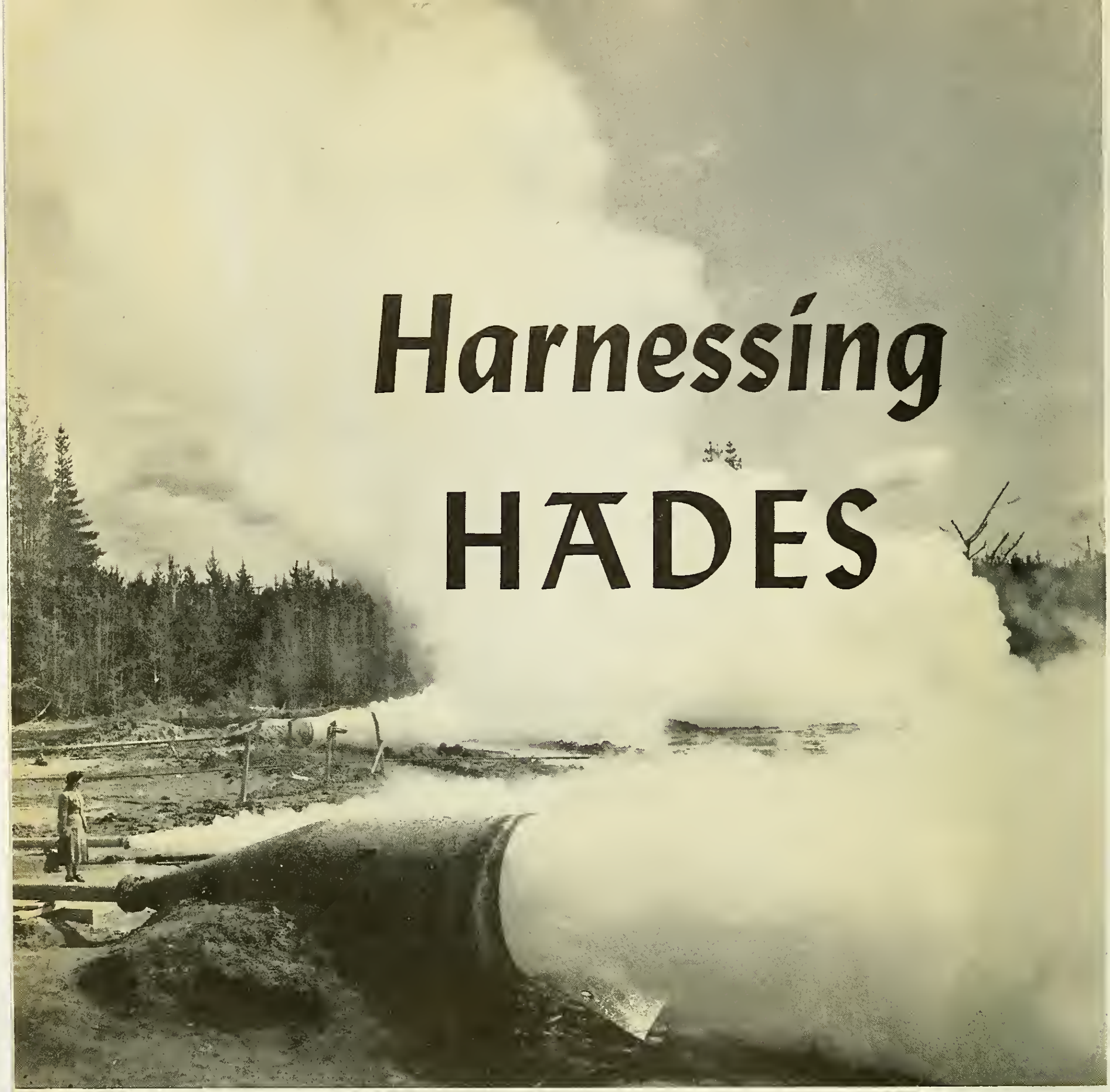
The Asiatic Cobra is awesome-looking but slow compared with rattlesnakes, copperheads, and moccasins.

I have not measured the exact speed of the boa's strike, but I am sure that it is as fast or faster than that of many pit vipers. Mr. Arthur Greenhall, Director of the Zoological Garden in Port-of-Spain, reported that he has fed live, wild mongooses to his boas on several occasions when other foods were scarce.

Fights between mongooses and various pit vipers occasionally have been staged in the West Indies. These fights, like those staged with cobras, usually end in a draw, but either contestant may be the winner. More often than not it is the pit viper. One movie-short circulated a number of years ago depicted a battle between a Western Diamondback Rattlesnake and a mongoose. Before the latter emerged victorious, two obviously different mongooses had taken part in the fight.

Cats, too, occasionally attack and kill venomous snakes, usually small ones. In Florida, house cats frequently kill coral snakes. Several years ago, Miss H. Vick described an interesting battle between her cat and a large black cobra in India. After a battle that would have done credit to any mongoose, the cat won. Kipling might just as well have made a cat the hero of his story. It is an equally authentic snake killer. However, he was too skilled a story-teller to choose a familiar animal as a hero, and he was concerned to portray the romance of the wild animal life of India. "Rikki-Tikki-Tavi" is a truly charming story, but like others of the *Jungle Tales*, it must be read as part fancy and part fact. Let us give the mongoose his due as a quick, agile, and voracious predator, by all means, but stop short of picturing him as the nemesis of all kinds and sizes of snakes.

Harnessing HADES



"THERMAL Wonderland," they call a section of New Zealand's North Highland, where geysers play and crystal pools suddenly froth like champagne. Tourists have thronged to the mineral hot springs for over a century, to the blowholes and spouting mud pools, the colorful waters and more colorful silica terraces around Rotorua; but only recently have people tried to harness the power from these springs.

Rotorua is the center of a thermal region that slants 170 wavering miles from the active volcanoes of Tongariro National Park, through Wairakei, Waiotapu, Rotorua, Tikitere, and on to White Island. Forty miles off the east coast, plumes of sulphurous smoke hang constantly over this temperamental islet.

In the resort areas, nature plays charming tricks. She places a blue lake next to a green one, a boiling pool immediately beside a cold pool, and paints the earth in colors ranging from white to yellow and mauve to crimson. Geysers bubble and streak skyward, sometimes as faithfully as clockwork, sometimes according to whim. Gaseous vapors ooze wispily from pores in the ground or swirl smokily out of caves, staining the rock with their mineral content. In spots, the earth's crust is so eggshell-thin as to burn the soles of your shoes when you walk on it.

In Rotorua, residents have put down two-inch bores, which provide an unfailing supply of hot

◄ NEAR THE CENTER of the thermal region, the Maori village of Whakerewarewa is clustered around the hot pools of a valley just outside Rotorua. The larger building near the center is the meeting house.

▼ WHEN THE STEAM IS TAPPED, equipment of this sort must be installed to control it and separate the water from the steam.

O. P. Bergelin photo

DANGER
KEEP OUT

The steam from New Zealand's geyser belt promises to solve her power shortage, but its use may impair the natural wonders of one of the world's most impressive thermal areas

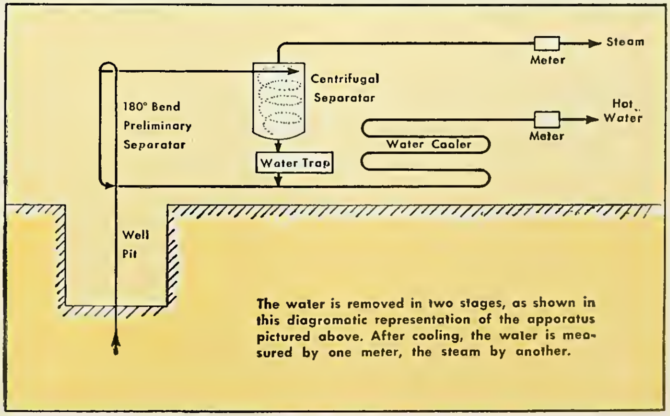
By

LYN HARRINGTON

Photographs by Richard Harrington except where otherwise credited

water for the household. Some backyards sport showers, where the owners can take warm baths with never a heating bill to pay. Natural steam has been harnessed to provide hot water and heat in hotels, mineral spas for those "taking the waters," and warm swimming pools for shivery bathers.

The Maoris around Rotorua were first to capitalize on the natural heat. For centuries, they bathed, swam, and washed their clothing in the pools. They used the hot



The water is removed in two stages, as shown in this diagramatic representation of the apparatus pictured above. After cooling, the water is measured by one meter, the steam by another.

water for cooking by putting the food into woven baskets and lowering it into the pools. Later they boxed-in steam vents to serve as communal waterless cookers, where the dinner cooked slowly with never a chance of burning the potatoes. Today they have built concrete laundering tubs in which Nature constantly renews the rinse water. Steel pipes now carry the hot water to homes and community halls.

Tongariro's several active volcanoes make a smudge on the skyline, visible for 100 miles. But volcanic activity does not deter hikers and skiers from the gently sloping mountains of this playground. Recent eruptions of Ngauruhoe were photographed almost at the crater's rim by a daring cameraman and have presented a nightly show for guests at the hotel.

Wairakei Stream flows through a deep trench in the hills, cold and clear, a favorite haunt for trout. But once in Geyser Valley, the water becomes too hot for the fish. Here ferns and mosses flourish in the humid atmosphere of boiling springs, infernal vapors, and leaping jets of water and steam.

The Paddlewheel Geyser chug-chugs, while the ton-and-a-half Dancing Rock bounces violently with pressure from below. Bridal Veil Geyser hourly spills down over a terrace of pink silica, while the Opal Pool turns its green terrace orange once a year, with excesses of copper. A few miles to the west, Karapiti Blowhole has been erupting a powerful jet of "dry steam" for the last 600 years.

The Maoris have a tale to explain all this thermal activity. Long ago, in 1350, when the great migration came from tropical Polynesia to New Zealand, the ancestor of the Arawa Maoris landed at Maketu on the east coast. He strode across the country to Mount Tongariro and claimed for his tribe all the territory over which he traveled. But he found New Zealand chilly after the balmy isles of his youth. So he appealed to his sisters, Fire Goddesses in his homeland. In compassion, they lighted fires all along his route.

Scientists have a different story. They term it a "trough, or fault line," through which the immense pressure of the earth's hot interior escapes.

In a valley at Wairakei, they are pushing long tubes down into the earth's innards to determine just what's there. Some 30 bores have probed through the pumice and mud stone, and the hot steam rushes from their funnels with the shuddering thunder of Niagara Falls.

New Zealand's increasing industrialization has spurred a search for new sources of electric energy. Five years ago, the Dominion "down under" turned geologists, vulcanologists, geophysicists, and engineers loose to make an intricate survey of the famous thermal region.

Where to Start?

No one knew exactly where to begin exploratory drilling. In choosing their site, the scientists employed air-borne magnetometers, such as were used during the war and later in oil exploration to measure the variations in the magnetic field of the earth's crust. They used rock echoes, with a seismograph to record vibrations from different layers of rock far below. Prospecting bores were studied for what they could reveal.

They finally selected a tiny fold of the hills between Geyser Valley and Karapiti Blowhole, one that showed little thermal activity of its own but an obvious "hot spot." Geothermal Valley, covering perhaps 2

➤ **Sulphur fumes** rise from cracks and caves at Waiotapu ("Forbidden Water") a few miles south of Rotorua. Crystals of sulphur as delicate as snowflakes decorate the cliffs.

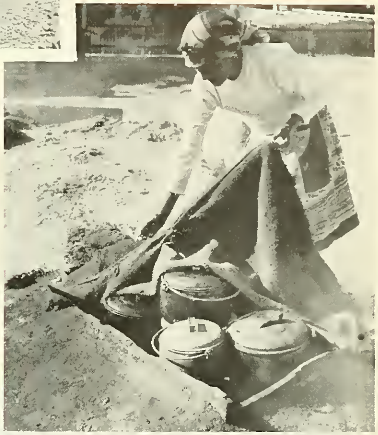
square miles, is only a tiny portion of some 3000 square miles equally rich in steam possibilities.

The first four-inch bore was thrust into the bank of the Waikato River, largest stream in New Zealand. It struck hot water at 200 feet. Thirteen other four-inch bores were sunk to depths of between 600 and 1100 feet. When the scientists measured one of these shallow wells, they found it discharging steam at a rate that would generate 1000 kilowatts of electric power. The largest well up to now, a 10-inch one, produces enough steam for about 6000 kilowatts, allowing for normal losses in power generation.

When a bore first "comes in," rocks and mud mixed with steam and water spout with a high shriek. The bore is left vertically open for a day or two until it clears itself out. Then the steam is channeled through a horizontal muffler to cut down the noise. The sound has been estimated at 150 decibels, compared with 140 from the exhaust of a Vampire jet. At close range, the vibrations, or shock waves, produce a strange unease in your body. Even with the silencers in place, the reverberations are deafening.

In March, 1951, when the first 6-inch bore was uncapped, debris and rocks were hurled 600 feet into the air. The following January, the men bored down to 1500 feet. Hot pebbles and pumice mud flew into the air, and the recorded temperature at the bottom was 489 degrees F.

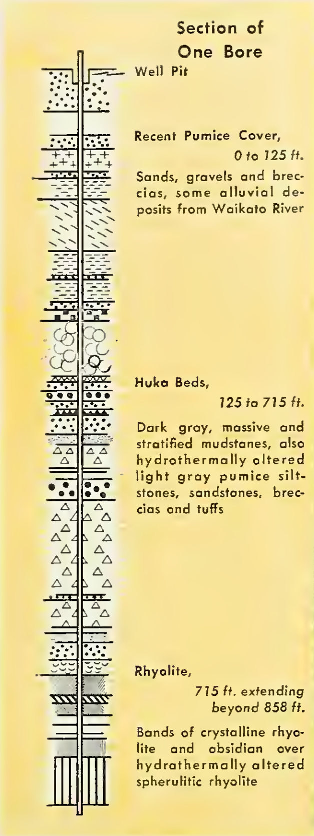
◄ A MAORI GIRL, wearing her traditional costume as a waitress at a local hotel, proves that you can cook an egg in the hot water bubbling up from the earth. It also tarnishes the spoon, however.



► A MAORI HOUSEWIFE sharing her waterless cooker with neighbors. "Nothing ever burns here," she says. The heavy matting is to enclose the steam.

▲ WITH CONSTANTLY FLOWING RINSE WATER, laundering has been a simple problem for generations at Whakerewarewa.

◄ OUTDOOR TUBS are popular at the Maori village, and there is no danger of anyone's saying, "Who used up all the hot water?"


Section of One Bore
Well Pit
Recent Pumice Cover, 0 to 125 ft.
Sands, gravels and breccias, some alluvial deposits from Waikato River
Huka Beds, 125 to 715 ft.
Dark gray, massive and stratified mudstones, also hydrothermally altered light gray pumice siltstones, sandstones, breccias and tuffs
Rhyolite, 715 ft. extending beyond 858 ft.
Bands of crystalline rhyolite and obsidian over hydrothermally altered spherulitic rhyolite

➤ SIGNS ARE POSTED for safety outside the buildings where tests are being carried on.

GEOTHERMAL RESEARCH STATION
DOMINION LABORATORY-S.I.R. DEPT.
THIS STATION IS TESTING THE CORROSIVE PROPERTIES OF GEOTHERMAL STEAM.
SOME PARTS MAY BECOME WEAK & DANGEROUS & THE PUBLIC ARE THEREFORE ADVISED TO KEEP OUTSIDE THE FENCE

➤ ENGINEERS have sunk at least 30 bores in Geothermal Valley to test the type and quantity of steam. A dozen or more of them are showing results.

Seeking different types of steam, preferably dry like Karapiti, the research teams imported new drilling equipment, much more powerful than before, from the United States, and probed deeper.

One deep bore went to 3189 feet. When opened, a great column of rocks, as large as a man's hand, rushed out the vertical pipe. In one well, some of the rocks lodged in the uncased section of the bore, blocking the flow, and had to be drilled out. After performing like a small volcano for an hour, the shower of rocks lessened. This bore built up a steady jet of dry steam.

Although drilling for steam is similar to oil drilling in many ways, it has the added complication of heat. The driller must watch lest an impatient Nature take over. Cold water is pumped down into the hole systematically to control the steam. Even so, the hollow ten-foot bit comes up with a boiling-hot core. Temperatures of the bores range far above the boiling point of water, and the rock below is estimated to vary between 1300° and 1800° F.

Half a mile down

The drills go down through porous beds of pumice and mudstone (indurated shale formed by the consolidation of mud) to around 2500 feet. There they encounter a layer of ignimbrite, a hard, nonporous rock. Scientists now believe that internal heat rises through cracks in the ignimbrite, heating the underground water.

Hot water rushing upward flashes to steam as it encounters the lower pressures near the surface. It isn't pure steam, since it contains water, salt, silica, and the gases carbon dioxide and hydrogen sulphide.

It has been announced in the press that the hydrogen is the rare form known as "heavy" hydrogen. There has been some doubt about this, but recent word indicates that a plan to produce heavy water is now being carried out under the British Atomic Energy Commission.

Dry steam is essential for turbines, and the scientists' next problem was to separate the water. This difficulty has now been overcome by centrifugal dryers. Although a complicated process, the production of this steam for turbines costs about the same as making electricity from water power, and about half as much as by using coal.

But the chief question the engineers ask is: "How much have we got down there?"

No one can make even a rough guess as to the amount of hot water lying in the bowels of the earth, ready to turn into steam. The potential resources can be assessed only by drilling more holes and measuring the flow.

The output of steam in the deep bores is generally much greater than in the shallow ones, but this is partly due to their larger diameter. Some show even a slight increase in volume over the year. It disturbs visitors to see steam roaring out of the mouths of so many bores in Geothermal Valley. Yet there is no other way of establishing the durability of the flow.

The New Zealand authorities forged ahead with plans for a 40,000-kilowatt steam station. It was designed for easy extension in the event that more steam would be tapped. If successful, projects like this could solve New Zealand's power shortage for a long time to come. Over to the east, a newsprint mill is sending down deep bores to tap resources there, and other industries are watching with great interest.

New Zealand is not the first to have harnessed geothermal power. Italy led the way about 55 years ago. The Tuscany Plain in north Italy has a thermal area much smaller than that of New Zealand. The Italian engineers at first drilled at random; but before the war, 140 bores were delivering steam steadily, driving turbines. Many more have been drilled since then and some abandoned. In 1951, they had an installed capacity of over 300,000 kilowatts.

How this tapping of the earth's heat will affect New Zealand's thermal wonderland as a tourist attraction remains to be seen. These activities are viewed with apprehension by the Tourist Bureau, which fears that exploitation of the steam may result in diminution of the geysers. Scientists admit that it could happen in time.

"It's already happening," a Maori guide at Geyser Valley said gloomily. "Two of our geysers aren't playing as they did, and they don't perform on schedule any more."

The geysers are notoriously erratic, and perhaps these two will come back. If they don't—well, the demand for power in this age of mechanization will present a strong threat to those who like to preserve the wonders and beauties of nature.

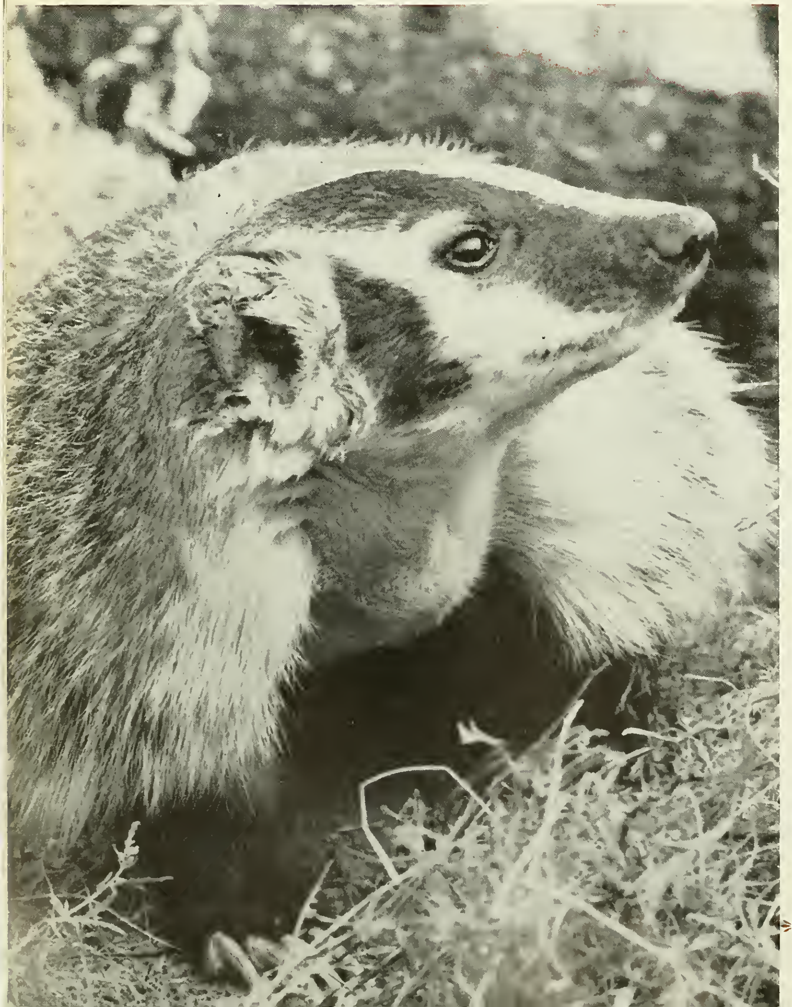
▲ **Louder than a vampire jet** in the ratio of 150 decibels to 140. Even with mufflers, the roar is frightful, and the vibrations leave the body trembling.

➤ **This four-inch bore**, opened in 1950, is still blowing steam without diminution. But local people fear that you can't harness Hades without killing the geysers. Time alone will tell.

This cousin of the skunk has no protective perfume, but he makes up for it with ferocity and a rugged unwillingness to die.

Better Not Badger the BADGER

By Willis Peterson



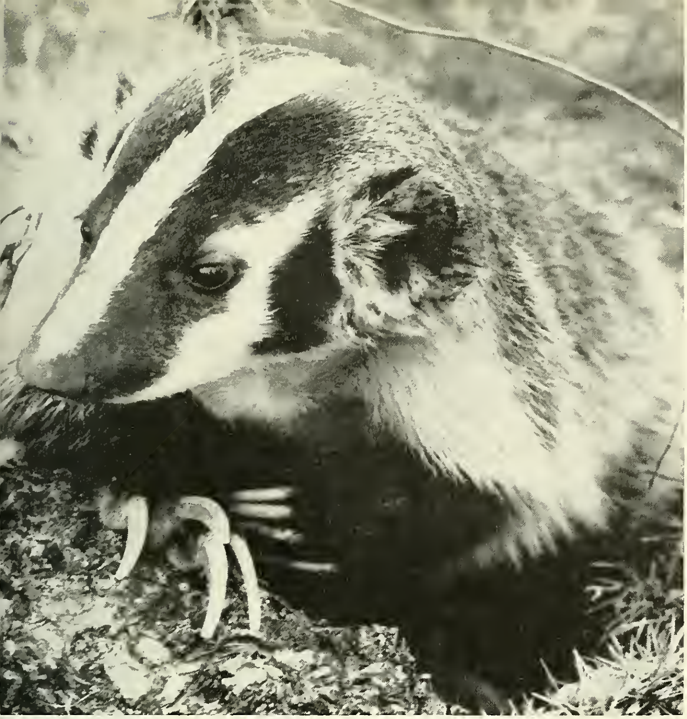
◄ **Males and females** look alike and weigh 13 or 14 pounds on the average. Large individuals may reach 23 pounds.

LOW-SLUNG, broad-shouldered, and pigeon-toed, the badger is a picture of a natural born fighter. He may seem awkward as he waddles about, but don't let this bow-legged shuffle fool you. In an instant, those slow, deliberate movements can change into a grizzled bundle of fury. Lashing out with rapierlike claws, he can easily dispatch a much larger adversary.

Years ago, promoters took advantage of these battling instincts and matched the badger with dogs. The dogs that were bred to rout him out of his burrow thus came to be called dachshunds, literally "badger hounds."

But what the dog may at first take to be an easy job is soon found to be quite a problem. More than one dachshund may well be needed to hold this frenzied quarry at bay. It was the badger's astonishing mettle that made him a favorite with wagering crowds.

If a badger is surprised by man and too far from his hole to scramble back, he immediately "digs in." A veritable geyser of earth mushrooms into the air, as



The claws on the front feet are over an inch long and very strong.

his front paws, equipped with two-inch claws, rip away the soil. Meanwhile, his stubby back legs constantly clear the dirt away in backward pushing motions. In an incredibly short time he disappears from view.

Probably for this reason he prefers to live in the arid plains and deserts. In terrain that would not permit him to dig in at will, he would soon be lost to his enemies.

Because of the badger's excavations, ranchers and cowboys do not hold him in high esteem. His holes and tunnels make dangerous pitfalls for horse and rider, and many a cowpoke has picked himself off the ground cussing a blue streak at this four-legged prospector.

On the credit side, the badger does much good in clearing out numerous rodents that plague the farmer and rancher alike. He rounds out his diet with roots, nuts, frogs, snakes, worms, and insects. He does not even turn up his nose at carrion.

The young usually number from one to five and are born in the spring. Their home lies underground in a hollowed-out chamber lined with grasses. Two or more tunnels lead to the den, with entrances sometimes 50 feet away.

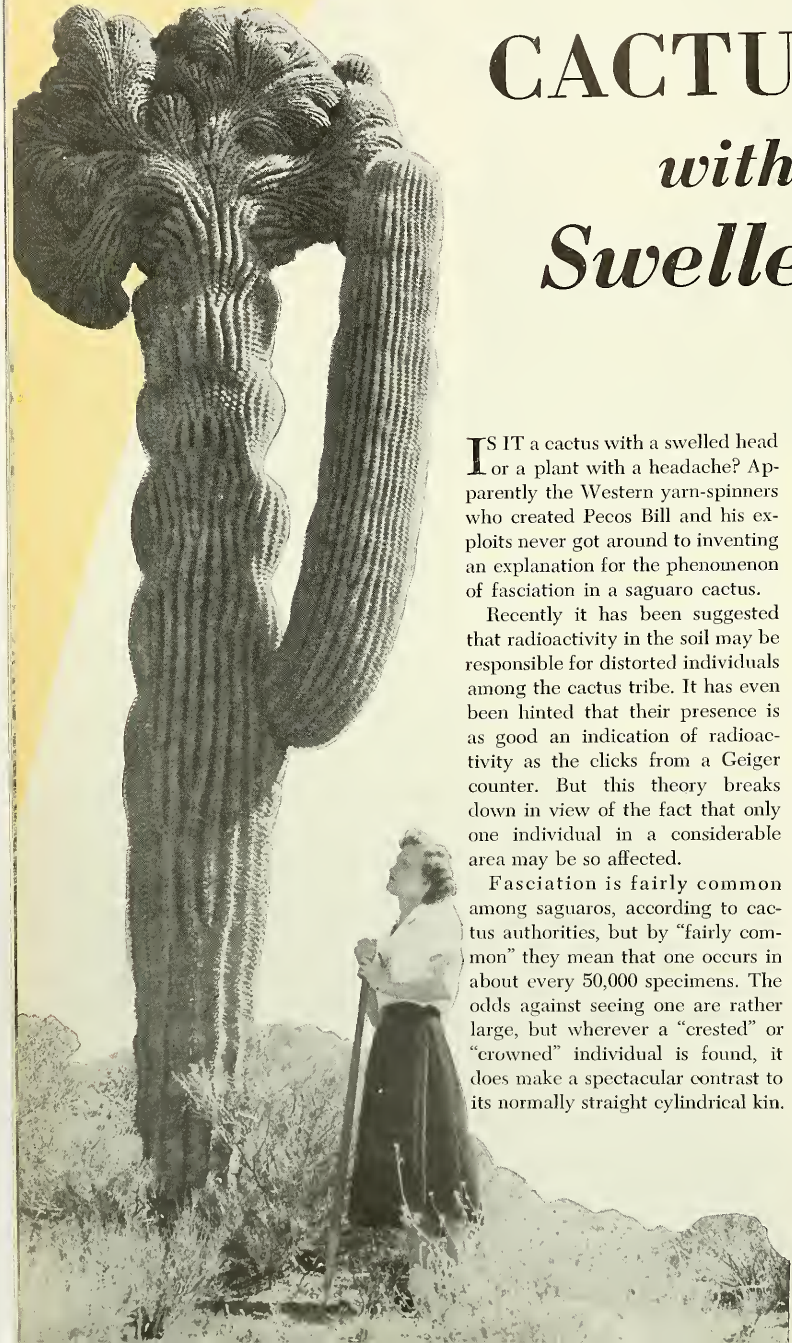
The badger is a species of the weasel family and cousin to the skunk. White and black stripes lead back from the nose and blend together at the shoulders, the fur is coarse, silvery gray, and grizzled with black. Badger bristles were once used for fine shaving brushes, bringing as much as $85 a pound. And at one time, the animals were raised in farms for profit in much the same manner as mink and fox. But speculators soon found that the badger's voracious appetite made it an unprofitable animal.

During short periods of semi-hibernation, the badger keeps snug by rolling into a ball in its long thick fur. If the animal becomes hungry during this time, it shakes the sleep from its body and ambles forth. After feasting a bit and carefully storing away any surplus provender, it resumes its semiconscious state.

The badger usually does its foraging at night, but it is not much of a traveler in its own right. Nevertheless, it has distributed itself from Canada to Sonora, Mexico, and from the Pacific coast to the Mississippi River.

The badger can dig itself out of sight in almost no time, and its muscular, compact body can survive punishment that would kill an ordinary mammal.

A gigantic example of fasciation in the desert north of Cave Creek, Arizona, reminds us that there are mysteries yet to be solved in the growing processes of plants.



CACTUS *with a* ***Swelled Head***

By Edna Hoffman Evans

IS IT a cactus with a swelled head or a plant with a headache? Apparently the Western yarn-spinners who created Pecos Bill and his exploits never got around to inventing an explanation for the phenomenon of fasciation in a saguaro cactus.

Recently it has been suggested that radioactivity in the soil may be responsible for distorted individuals among the cactus tribe. It has even been hinted that their presence is as good an indication of radioactivity as the clicks from a Geiger counter. But this theory breaks down in view of the fact that only one individual in a considerable area may be so affected.

Fasciation is fairly common among saguaros, according to cactus authorities, but by "fairly common" they mean that one occurs in about every 50,000 specimens. The odds against seeing one are rather large, but wherever a "crested" or "crowned" individual is found, it does make a spectacular contrast to its normally straight cylindrical kin.

Fasciation is found in many species of the plant world. It is "a condition due to the failure of lateral shoots to separate normally from the main axis, producing flattened areas, sometimes several inches wide, and where the leaves are normally opposite, often spirally contorted, as well," to quote from the Royal Horticultural Society *Dictionary of Gardening*. In the case of the giant saguaro cactus of the American Southwest, the affected area is several feet in extent.

While it is generally assumed that abundant supplies of plant food and water tend to bring about fasciation, the exact causes are unknown. Actually, none of the commonly suggested causes, which include heavy feeding, attacks of bacteria, or mutation of the principal stems, can be relied on to produce the condition.

Garden cockscomb is the best known plant in which fasciation is a normal and desired state.

Letter from Kenya

Editorial Note:

A few months ago, Natural History Magazine published an article that analyzed the causes back of the Mau Mau terrorism in Kenya, East Africa. We now offer our readers this more personal account, telling what the conflict means to farmers and other settlers living in the region.

WE HAVE become so accustomed to carrying our pistols and rifles with us wherever we go that the days when this was not necessary have receded into the past. We used to sleep soundly at night, unalarmed when the dogs barked except to wonder vaguely if some animal were about. We walked around the farm, unapprehensive when we met a strange African. After exchanging greetings, we would ask what his business was. We looked forward with some pleasure to an occasional week end in Nairobi and had no fear that in our absence our property would be in danger of being raided or destroyed. Those days are over.

I live on a farm seven miles from a village, which I visit only once a week on a shopping expedition. Most of us shop on Wednesdays or Saturdays, as these two days divide the week nicely for the delivery of cream to the Creamery. This is a big ranching district, but our farm is only 300 acres, tiny in comparison with most of the others.

During the day, when the sky is blue and the snow on the crest of Mount Kenya sparkles in the hot sunlight, it is difficult to believe in the evil that is walking abroad. But at night, we lock ourselves in the house and sit with our guns close beside us, alert for the slightest sound that would betray the presence of danger. Every bush is a possible hiding place, shielding in its dark shadow a darker form. It is easy then, when peering out into the night, to endow the landscape with movement. Are you *sure* it is only the frangipani shrub on the lawn? I thought I saw it move.

When the dogs bark, we grasp our guns and tiptoe to windows in darkened rooms to peer out with straining eyes. Sometimes we see a rocket going up, or a flare, meaning that someone is in trouble and calling for help.

We have a party line telephone that serves ten farms besides our own and also a Police Post. The last few nights there have been numerous incidents, and the young officer at the Police Post has telephoned everybody on the line to ask if we have seen or sent up the rockets that have been reported by a man on duty in the watchtower. We hear dull explosions like mortar fire. Who is in trouble tonight?

Under the sun once more, the great spaces become beautiful and we forget the hideous sore that lies festering out of sight. But the quiet is broken sometimes by the hum of an aircraft flying high above. The hum changes to a whining roar as the plane dives, and there is the rumbling crash of an explosion. Smoke and dust rise high above the darkness of the forest. Has the bomb killed a few terrorists this time or has it merely destroyed more of the wild animals, who flee in terror to the sanctuary of the lands below the forest?

The farm laborers go quietly about their work, not raising their eyes to watch the aircraft. It is impossible to guess their thoughts, to know whether they are loyal to us or whether they have taken the dreaded Oath and are waiting for orders to join in an attempt to kill us. We can only continue to be watchful and hope that we shall have sufficient warning to give a good account of ourselves if an attack is launched.

The dry season is over, with its fear of bush fires. Streams are running strongly, the dams are full, the grass is green, and the cows are getting fat. Our river rushes around the bend where the pump is installed in hissing, foamy waves. It gobbles up the rocks that lie in its path and bends the dancing ferns until they lie flattened against the moss.

The ducks and geese conduct bathing parties in the flower borders, diving and coming up festooned with plants. The buck and hares that nibble the roses and carnations in the dry season have moved off now that there is plenty of food elsewhere.

The rain has caused a crop of colds and flu amongst the staff, who drift up to the house in relays for cough medicines and eucalyptus oil to rub on their chests and aspirin to clear their headaches. When it is raining, they all work in a big shed near the dairy, stripping felled trees to be used as fence posts or for other building purposes and doing other indoor jobs. They build a fire in the middle of the floor and get as close to it as they can. Then they go out in the rain and catch cold.

It is my shopping day. I make out my list, which includes paraffin [kerosene] for the refrigerator and the lamps, worm medicine for the laborers and also *tumbak*, the native snuff made up into small spills. There is a film to be developed and printed by the local photographer (the Africans love having their photographs taken) and a sample bottle of dip for analysis by the Veterinary Officer. We take two boxes of eggs, our cream to the Creamery, and a young calf destined for the abattoir. The latter is a most distasteful duty. We hand-rear our calves, and they become pets. On a small farm like ours, we cannot keep the bull calves, so they have to be sold to the butcher.

Our farm road, once good, is now badly cut by the heavy army vehicles using it for the many operations against terrorist gangs. The river running through the farm has banks heavily grown with forest and bush, which are known to harbor these gangs. The recent rains will mean trouble for us in reaching the Tarmac of the main road.

Once on it, the journey to the village is pure joy. The air is like wine, the sky blue, the sun shining. Ahead, the road dips and winds and climbs, and we can see for miles across the far plains to the horizon. On our left, the great Mountain rears its dark slopes, colored a rich royal blue in the clear morning light, the snow on the peak glittering intensely white. Often there are zebra grazing among the low thorn trees. Sometimes a troop of baboons lope across the road, leaving one of their number behind to sit on a fence post and watch us pass.

We look forward to meeting friends in the village and exchanging gossip and news over a cup of coffee in the rather tawdry little cafe, Indian-owned and managed. Perhaps an invitation to lunch on Sunday? Lovely, though we shall have to leave almost immediately afterwards, for we have no farm

continued on page 444

nature unspoiled

"The greatest meeting of land and water in the world."

Point LOBOS

THE twisted and gnarled Monterey Cypress of our California Coast fought a desperate battle for survival against wind and fog and drenching spray. It won this round with the elements, but almost lost the battle with man. With the existence of the Monterey Cypress threatened, we are only beginning to find out its history.

Now, only one virgin stand of this beautiful tree remains. Fortunately for nature lovers, its life is no longer hanging in the balance. The Monterey Cypress is protected in the 400-acre Point Lobos Reserve State Park, which is about 100 miles south of San Francisco.

Point Lobos has been described by the painter Francis McComas as "The greatest meeting of land and water in the world." Its recent history has been precarious. Rumor has it that during the free and easy days of the Mexican regime, Point Lobos was lost in a game of cards. It became the site of a whaling station and the shipment point of a coal mine; it was laid out on paper as a town site. Finally, in 1898, it had an owner, Mr. A. M. Allen, who appreciated its beauty.

Through financial assistance given by the Save-the-Redwoods League and public-spirited individuals, including Richard Harkness and A. M. Allen, the State Division of Parks was able to acquire the area in 1933 as a Reserve. The layout was planned on a careful survey financed by the Carnegie Corporation and the Carnegie Institution of Washington. The finest areas are to be entered only on foot, over unobtrusive trails.

Point Lobos is interesting for many reasons. Even the casual visitor is likely to gain some insight into the geological history of the Reserve. There is wildlife in abundance, including at least 300 species of plants, 147 birds, 10 amphibians and reptiles, 19 mammals, and 88 marine invertebrates along the shore and in the tidal pools. The diversity is ascribed partly to the number and variety of habitats, including grasslands, brushlands, forests, ocean shore, and islands. The animal that attracts the most attention at Point Lobos is the Stellar sea lion, which lives in the offshore waters. The pocket gopher is abundant in one-third of the Reserve and plays a large part in modifying the upper soil.*

NATURAL HISTORY Magazine salutes the institutions and individuals whose forethought saved this unique region for the public.

**For further information we refer visitors to the booklets* Point Lobos Reserve *and* Point Lobos Wildflowers.

continued from page 398

Gilbert Stuart, and a hundred like them, not to count his associations with Napoleon and with most of the crowned heads, presidents, and statesmen of three continents.

Dr. de Terra's book is the fruit of prodigious sifting of the publications and manuscripts of Humboldt and his contemporaries. It owes little to earlier and, in some instances, more subjective biographies. For all its labor, the work reveals the difficulty of separating grain from chaff in so complex a harvest, and it is not always easy reading. It is, however, to a high degree illuminating and revealing.

Humboldt was born with endless curiosity and tireless drive. He was a democrat, a liberal, and a humanitarian a century ahead of his time. He was generous despite a strong strain of vanity, and candid and forthright, even though affected by poorly understood psychological peculiarities. He knew the classical languages as well as most of the modern tongues of Europe, and he could write letters in Hebrew and Sanskrit. He could draw skillfully, and he had a highly developed critical appreciation of the visual arts; yet music apparently meant little to him.

Dr. de Terra traces Humboldt's career from his birth and misunderstood childhood in Prussia through all his accomplishments and wanderings, his original investigations in physiology, terrestrial magnetism, volcanology, anthropology, and plant and animal geography, and his formidably voluminous writings, to his funeral—which sounds like a pageant out of *Alice in Wonderland*.

The author lists 24 (but by no means all) of the localities and phenomena throughout the world that now bear Humboldt's name. He recounts his profound influence upon rising stars in a new firmament, such as Charles Darwin, who inordinately admired him. Yet, it was this same Darwin, and other prophets of a supremely creative phase of science, who have inadvertently eclipsed the earlier "flame of knowledge," the well-nigh omniscient Humboldt.

R. C. M.

HOW TO WATCH BIRDS

- - - - - - - - - - - - by Roger Barton

McGraw-Hill, $3.50
229 pp., numerous drawings

MR. BARTON, president of the New Jersey Audubon Society and a nature columnist for the *Newark Sunday News*, has learned both from personal experience and from contact with others the pleasures and problems of studying birds as a hobby. He has carefully organized this fund of information and presented it in a book that contains much new material and covers the field with a thoroughness not to be found elsewhere.

The author begins by discussing the reasons for the great increase in the number of individuals interested in bird watching since the last war. People from all walks of life and of all ages have, as Barton emphasizes, found in this pursuit a relaxation from some of the tensions inherent in our modern way of life. Then he goes into such questions as how to find birds and identify them, the purchase, use, and care of binoculars, and how to record notes. There are also hints as to how to attract birds to the suburban household by the use of bird houses, feeding stations, and the like, and also by proper landscaping.

As already indicated, *How to Watch Birds* contains a much wider variety of material than might be suspected from the title. It includes lists of good books about birds and information about local bird societies and the more important national groups. Of special interest is a series of short biographies of famous American "bird watchers" from Audubon on down.

Mr. Barton's book can be highly recommended to all who are interested in the hobby of bird watching.

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The Screen

Authentic comments of films in the field of nature, geography, and exploration

Edited by Elizabeth Downes

The African Lion

Reviewed by Harold E. Anthony
Deputy Director, American Museum of Natural History

WALT DISNEY has moved into Africa to get a "True-life Adventure" feature, and the animal that plays the leading part is the lion. Like the natural history films Disney has based upon American wildlife, "The African Lion" is a splendid motion picture in color with a reasonable and logical sequence, good commentary, and suitable sound effects.

Three years of preparation went into this picture, and the competent field party had full co-operation from the staffs of five of the large national parks and game reserves of eastern and southern Africa. The story gives a pretty good idea of the every-day life of the lion, and this brings in much of the activity that takes place in African game fields. The lion apparently proved a patient and tolerant subject, and many of the "shots" are close-ups.

The lions are first seen in quiet family groups, with an old male, several lionesses and young of varying size, and in surprisingly close proximity to indifferent game which may, later on, furnish a meal for the lions. The big cats lie in the sun with all of the abandon of well-fed house cats, and the kittens romp and play about. When lions are hungry the scene changes, and the tempo steps up. Several incidents of the stalk are shown, and if this should disturb some who see the film, it should be borne in mind that lions are carnivorous and must kill to live. This section is stark and dramatic, for a lion has terrific speed and power; the kill is practically instantaneous. Then the whole group share the kill, and the little that is left is cared for by the scavengers.

There are also some fine recordings of the activities of other mammals and of birds in "lion land." The film is interesting from start to finish, and the few lapses that occur will be noticed only by a naturalist

As a whimsical prelude to "The African Lion," Disney has a musical cartoon fable of Peter and the Wolf, which presents a new and amusing interpretation of the Prokofiev version.

Released by Buena Vista Film
Technicolor
Running time: 75 min.

The Naked Amazon

Reviewed by Edward M. Weyer, Jr.
Editor, Natural History Magazine

THIS film is the outcome of the expedition described in the March, 1953, issue of NATURAL HISTORY in an article entitled "On Location in the Amazon" by Zygmunt Sulistrowsky.

The film is a fictionalized account, which jumps back and forth between actual events in the life of the expedition and dramatized incidents. The dangers are, in this reviewer's opinion, overstressed; and some of the animals are needlessly misnamed. But the sequences showing totally uncivilized Indians of Mato Grosso in their dances and daily life are excellent. The scenes were not easy to photograph in this primitive wilderness, particularly the ones showing the Indians playing on a sacred flute, which the audience might like to know is never permitted to be seen by the women of the tribe. These portions of the film are a creditable achievement in preserving a graphic impression of life in the kind of primitive communities that will almost certainly disappear or be greatly modified within a short time.

Released by Times Film Corp.
Color
Running Time: 69 min.

Simba

Reviewed by **Harold E. Anthony**
Deputy Director, American Museum of Natural History

THIS picture is fiction and of a character ordinarily by-passed by Natural History. But the American Museum has been identified in the past with a film entitled "Simba" (Swahili for lion) and some confusion may arise.

The present "Simba" is a stark and dramatic portrayal of the Mau-Mau problem. It is a strong diet for those who can take it, but African natural history is incidental.

A WALK IN THE WOODS

continued from page 416

be finer than gray ledge rock, covered with a natural patina of lichens and mosses; then the burnt orange and madders of dead ferns against deep green hemlock and pine, accented in just the right places by white birch?

And what does all that do to me? How do all these unfamiliar sights and sounds and scents—so natural, yet so foreign to the man-made world of concrete and commerce—affect me? I feel that an intangible something has, for a time, released me from convention. I have been natural and free to do as I please. I have really met *me*. Though alone I was not lonely; I felt none of the deep emptiness that one often experiences in a huge crowd where not a single face is recognized.

In the woods, even though I walk alone, if I travel slowly enough and with observing eyes I will not be without company.

Early November, in all but the most northern places, is the best time to see late-season migrant birds. Hawks of several species, owls, wildfowl, and many of the smaller birds linger until the first hard storm, seemingly reluctant to start the long southward journey. They are sociable now, having forgotten the rivalries of mating and nest guarding. Juncos and several species of sparrows will be found hobnobbing like old cronies; and hordes of robins, often numbering more than a hundred, surprise the casual observer who customarily sees only a pair or two on the lawn.

Chipmunks and squirrels, being among the less furtive of forest creatures, are commonly encountered. But if I tread softly and have regard for the direction of the wind, if I cultivate the principles of woodcraft, I stand an excellent chance of seeing the flashing red coat of a fox. Or I may surprise a fat and prosperous-looking old ring-tailed 'coon, washing a stolen ear of corn in some secluded brook. These exciting adventures may be experienced almost at civilization's doorstep.

Perhaps I may find a marsh inhabited by that interesting aquatic animal, the muskrat. Sturdy, rounded houses, cleverly constructed of flags and cattails, indicate the home of a thriving colony. A silent, hidden approach and a period of patient waiting may let me join the family and live, through my eyes, with the workmen, particularly on a soft, gray day. A long V-shaped wake on the water spreads from a pointed head with beady black eyes. The swimming animal is trailing a piece of flag. Winter is coming, and he is providing for it now with food and shelter. He is also comforting me with the proof that we humans aren't the only ones who have to work for a living and lay aside for the future.

It's late afternoon and time to start for home. I'm tired physically, and dinner will be welcome. But spiritually I'm right on top. The load of human worries I bore in the morning has noticeably lifted. Crisp, dry leaves make a pleasant crackling sound as I scuff through them; strange, half-forgotten scents are breathed in eagerly—the dank smell of a brook in the hollow, the delicious tang of dead poplar leaves. It carries me back to childhood when nothing seemed so very important. Come to think of it, maybe the things I had been worrying about aren't really as weighty as I was led to believe.

For a time, at least, I have been close to earth, as the Creator intended me to live. I have not escaped reality; I have *experienced* it.

It has only been a walk in the woods—a quiet day spent in the open. There has been no artificial excitement, not even the thrill of sport. I have had time to think about certain basic truths, and my spirit is peaceful. As I open the door I wonder if I am coming home in the only sense that man knows.

Have I not also been "home" all day?

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continued from page 440

guards and the house servants get nervous if we stay away long. Also, we have poultry to attend to.

There is one broad street in Nanyuki, running north to south and flanked by tall, gangly blue gum trees. The first impression a stranger would receive on being dropped into the village would be of the multitude of guns. There are rifles slung over shoulders, revolvers and pistols on belts at the waist or dangling in leather holsters. If a gun is not visible, one may be sure it is concealed in a pocket or handbag, though the latter is dangerous as the bag can be snatched. Great towering army trucks, painted jungle green, go roaring up the one street; jeeps and Land Rovers fuss importantly after them, bearing armed men in uniform. There are soldiers walking on the pavements or peering in at the few shop windows.

A war? Yes, we are at war. Our enemy hides in the bush and the forests and comes out at night, burning and murdering and maiming. Men, women, children, cattle —all are open to attack. Any of us here on the village street may return to our farms to find that we have been selected as the next victim.

The dingy little one-storied shops with corrugated iron roofs stand in a line beyond the trees under which the cars are parked. Most of them are owned and staffed by Indians. We go in and out of them, vainly searching for some gloves to wear to the wedding next month. Many of the Indian shopkeepers do not know what we mean. "Hand-gloves?" one of them asks in a tone of unbelief. We so rarely wear gloves that mine have gone moldy.

I buy some whistles for members of the farm staff. The house servants have already got theirs, to blow in case of trouble. Anybody hearing a whistle is instructed to bang the farm gong at once to summon everyone to the house so that we can all be together if there is trouble.

We deliver our eggs and cream, and take the calf down the bumpy road to the abattoir, a little stone building set in the plains. Disgusting, naked-looking maribou storks hover around, waiting for the tidbits they know will come. We part with the calf with more than a hint of tears on my side. I remind myself that there must be no sentiment in farming, but it is hard to live up to this. I long ago made a vow never to buy veal from the butcher; we might be eating one of our own calves, one we knew intimately. The man in charge, a tall smiling Somali, is instructed to kill the calf at once, and this he promises to do. We drive away, more than half convinced he will forget his promise.

Back to the shops to collect our groceries from the fat, smiling Indian grocer; then to the butcher for the meat. The basket is heavy and contains far more meat for our dogs and our beautiful pampered white cat than for ourselves. We load up a bag of *posho* (maize meal) for the laborers, collect our cream cans from the Creamery,

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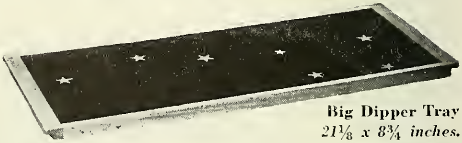

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then home. The Mountain is obscured by cloud, and we anticipate with sinking hearts the journey along our heavily rutted and slippery farm road, for rain has fallen during the morning.

Our fears are more than justified. We skid into the ditch and have to dig ourselves out, getting very muddy and wet in the process. Thank goodness, I remembered to bring my wellingtons, otherwise my flimsy "town" shoes would have been ruined.

Home at last. A late lunch and then work. The rain stops just after tea, and the sun comes out through a break in the clouds. It throws long fingers of golden light across the upper slopes of the Mountain, revealing great rifts and valleys and giant rock formations. The color changes to rose and then to palest pink and slowly darkens to purple, as the shadows lengthen, and all light fades out of the sky. I glance toward the place where the Mau Mau hide-out was discovered a hundred yards or so from the dip, well-stocked with food and blankets and some medical equipment as well. A battle had to be fought in the long paddock in front of the house before the hide-out was discovered, during which eight terrorists were killed and several wounded. We had had to remain indoors, for the bullets seemed to be flying in all directions. The dead bodies were stretched out on our farm road so our laborers could be taken to see them in the hope that the sight would frighten them sufficiently to keep them out of similar mischief.

It is not wise to go out-doors after nightfall. There may be an ambush. It may be a plot to lure one from the comparative security of the house. A farmer and his wife were murdered in such a way one night when they answered a call by one of their own staff to come and attend a sick horse. Once when a Mau Mau gang tried to raid our house, they fled in disorder, bullets whistling all around them. But the cook and house boy fled with them. They had been in the plot to murder us.

I like the daylight. The nights I somehow endure.

MRS. E. PICKERING

Morengai Farm,
Kenya Colony.

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DEMETRA is a lively, mischievous 15 month old baby with light brown hair and a face always scrubbed shiny and clean. She toddles around on the floors, generally gets in her mother's way, and gurgles over her doll.

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The only "home" Demetra has known is a refugee camp in Athens—a large warehouse partitioned off with ropes and rags to make "rooms" for many families.

Demetra's mother has sold most of the family's possessions, even her own winter jacket, to buy milk and bread for the baby. Demetra's father, a newspaperman before the war, has been unable to find employment. He is hard working and conscientious, but in poverty-stricken Greece there is little opportunity to earn a living wage. In a country where tragedy and sorrow walk hand in hand, Demetra's parents can only pray that someone —somewhere—will help their tiny daughter.

HOW YOU CAN HELP DEMETRA

You can help Demetra or another needy baby through the BABY SPONSORSHIP plan of Save the Children Federation. For only $60 a year, $5 a month, SCF will send "your" baby, food—including extra milk and cereal—attractive new clothing, warm bedding and many other essential items—delivered in your name in Greece, Finland, France, Western Germany or Korea.

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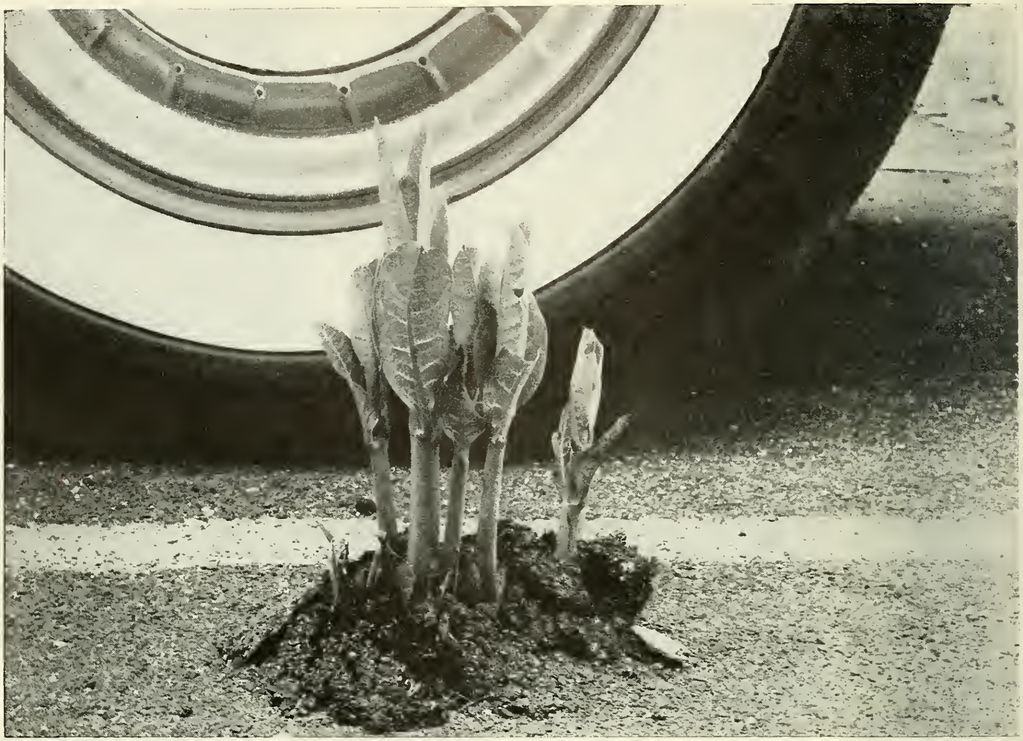

LETTERS

Umph!

SIRS:

HERE is an example of the persistence of nature. The surface of the road is three inches of asphalt black-top, rolled by a five-ton roller. The black-top was applied at a temperature of 400 degrees Fahrenheit, in July 1954. Beneath this was four inches of crushed rock. So we can hardly say that the milkweed plant is a Casper Milquetoast when it comes to getting its way.

ARTHUR C. FROCK
Springfield, Ohio

SIRS:

My husband and I are finding great enjoyment in each issue of NATURAL HISTORY. It is a new subscription—yet we have grown to look forward to each issue.

MRS. R. A. SAYE, JR.
Miami Beach, Fla.

SIRS:

I received a gift subscription to NATURAL HISTORY last year and wish to tell you how pleased I am. Each month brings such fascinating articles and interesting illustrations. I especially enjoy the back of the book item called "The Screen" in which readers are informed of the whys and wherefores of films dealing with nature, adventure, etc.

Please continue "The Screen." I enjoy getting on the "inside" of Hollywood motion pictures.

GWEN MEZA
Chicago, Ill.

Growing Things Concentrate Uranium

Two University of Wisconsin botanists have found that the native prairie plants and virgin forests in Wisconsin and the southern Appalachians literally collect and concentrate the metals known as rare earths, including uranium and radium.

Professor John T. Curtis and Ralph Dix told scientists attending the annual meeting of the American Institute of Biological Sciences that this might be why seedlings of some forest trees—notably hemlock and yellow birch—mysteriously die soon after germination.

Using a scintillometer, the scientists measured the radioactive metals present in the soil. Conventional chemical methods further showed the presence of boron, copper, gallium, lead, silver, zirconium, lanthanum, nickel, vanadium, and yttrium. These metals were present in remarkably high proportions in the uppermost soil layer under both virgin forest and prairie. The botanists believe that these metals are collected along with nutrient minerals by the root network from as deep as the roots penetrate and are then deposited on the surface in falling leaves. On the surface, these rare earth metals are taken up by the plant's surface roots and pumped to the leaves, season after season, while the deep roots continue to absorb more metals from deeper soil. In this way, a concentration is eventually built in the soil's topmost layer.

The alpha radiation showing the presence of radioactive metals was found to be most intense under hemlock and yellow birch forests. Another University of Wisconsin botanist, Harold A. Goder, has contributed the information that 95% of all mature hemlocks grew from seeds that fell on stumps or mounds created by fallen trees. Out of all this comes the possibility that the seedlings may be unable to withstand the toxicity of the rare metals found in the upper soil layer.

Unfortunately, the radioactive minerals are present in such small quantities as to be of no commercial value.

America Beautiful Contest

The National Life Conservation Society is offering prizes of $100, $50, and $20 for the best original poems about our National Parks. The object is to arouse an appreciation of these outstanding areas and to prevent neglect or exploitation from impairing their natural beauty.

The contest is open to anyone residing in the United States. It closes March 1, 1956. All poems must be original, and only one poem may be submitted by a writer. The poems must not exceed 24 lines, and no poems will be returned. A fictitious name should be signed to each poem, with the correct name and address of the writer in a sealed envelope.

The poems should be sent to Mrs. Charles Cyrus Marshall, President, National Life Conservation Society, 2239 Tiebout Avenue, New York 57, N. Y.

All poems must refer either to the National Park system or to one or more specific park areas.

The contest has the endorsement of the National Park Service.

More Visitors at Wildlife Refuges

An increase of 11% over the previous high made 1954 the record year for the number of persons visiting our national wildlife refuge system, according to the Wildlife Management Institute. Visitors came for picnicking, swimming, photography, observation and study of wild life, but most frequently of all for fishing. The two refuges receiving the greatest public use were the Crab Orchard National Wildlife Refuge in southern Illinois with 864,300 visitors and the Wichita Mountains National Wildlife Refuge in southwestern Oklahoma with 852,316. This is the same Wichita Refuge that is threatened by the Army's expansion of its Fort Sill Artillery School.

The total number of persons visiting all of our national wildlife refuges in 1954 was 5,202,260.

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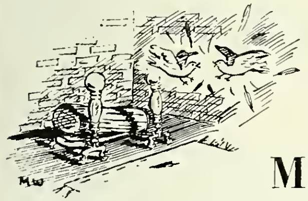

Fighting MOCKINGBIRDS

By Percy L. Day

LAST spring, late in the mating season of the mockingbirds, I was seated near the fireplace in my living room in Bear, California, when I noticed a considerable commotion behind the screen of the fireplace. There were chirps, squeaks, and much scratching and flapping of wings.

Leaning forward, I was amazed to see two mockingbirds, covered with soot, engaged in fierce combat. They had come down the 12-foot chimney and were paying not the least attention to me six feet away.

My best guess was that one of the birds had trepassed into the territory the other had "staked out," and that in the resulting fracas both had tumbled down the chimney.

My problem was how to get the two birds out without having the light-colored walls of my living room spattered with soot.

After studying the situation a few moments, I pulled down the blinds and closed the drapery on all windows except one opposite the fireplace, which I now opened.

Meanwhile, the two birds were still chattering and sparring. When I opened the screen, I expected both of them to dart for the bright open window. One did—at tremendous speed. But the other, which I took to be the rightful claim owner, promptly disappeared back up the chimney the way he had come in.

Soon afterward I heard him singing at the chimney-top, no doubt warning all future rivals to keep off his preserve and advertising his superiority to the lady of his choice.

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continued from page 12

strap almost before I knew it. The cranes disliked to see me depart in the auto or ride away on a tractor. In addition to protesting vocally, they would sometimes fly along until it was necessary to turn around and place them in charge of someone who could divert their attention.

One day we walked three miles on sandy wooded trails and past marshes. I would stop while my birds ate grasshoppers and blackberries and splashed and waded in the water. It was a hot day, and we rested in the shade from time to time. We were making an extended circle, the last portion of which was suggestive of walking through an oven. When we were still a mile from home and had come to a little opening, the cranes apparently decided that all this walking was very stupid; they ran, took off, lifted over the trees, and left me to finish my walk by myself. Fifteen minutes later, when I came panting up to the house, there were Turk and Silver, nonchalantly preening their feathers, and obviously quite oblivious of my wounded feelings.

Call of the Wild?

I remember another walk in early autumn. Turk and Silver had taken wing and were circling the half-mile-long Corner Marsh. They were beautiful to see, and I was proud of them. I stood waiting for them to come back; to alight beside me in the field. They swung around the marsh twice more, turned northwest in the direction of marshes where wild cranes lived, and then flew, and flew, and flew—far beyond sight. After all, Turk and Silver were free, and if they wanted to go wild, that would in a way be a great triumph; yet I could not wish it because they trusted humans too implicitly. In a month or two they might start off with their fellows for the South—a 1000-mile journey to the wintering grounds—and sooner or later they would approach a man with gun or club, and their friendship for people would lead to their own destruction.

Once I had watched a flock of cranes begin their southward journey. They had started by circling, as Silver and Turk had just done, but rising higher and higher in great sweeps, chimneying up, and up, and up, until they became specks in the sky, wheeling upon set wings, and drifting southeastwardly, trumpeting and bugling in a continuous chorus; and the sound was soft, ethereal, with an indefinably moving quality. The flock disappeared for another season. The music faded, yet lingered with me. It would be wonderful if Turk and Silver—but I had not even said *"Good bye!"* If only I had been able to teach them proper crane traditions, to be eternally wary, to fear men, to trust no one, and to forage and glean a natural living, I should have been happy to have seen them go. But I could not tell what they might do, or whether they could, or would, learn wild ways. As I waited wondering, the minutes were very long. Then, above the woods, I saw two great birds flying side by side, wings beating rapidly, the tips of the primaries spread, long necks and legs extended full; and they were the most graceful, the most beautiful, of all the wonderful birds I have ever seen. In another few moments, two sand-hill cranes lowered their legs, slowly tilted their wings for landing, came down with a few bounces and a short run, and then walked toward me, talking softly. It was the sound I most wanted to hear, for it told me that Turk and Silver did not want to go wild. I thought of the bugling music of the wild flock drifting South, of the great wheeling circles with earth far below, of how marvelous it would be for my birds to be part of the vast, wild, migrational adventure, and I was very sad, but at the same time I was also very happy—as we set off down the field to hunt grasshoppers together.

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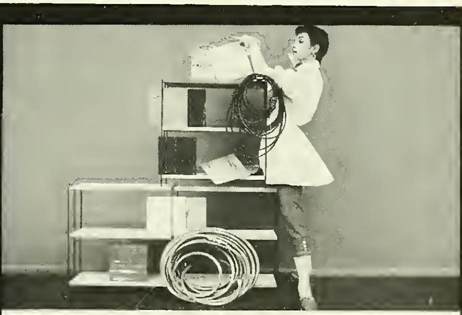

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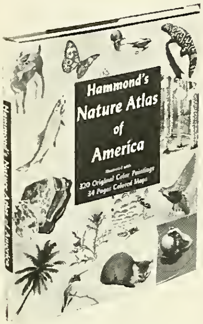
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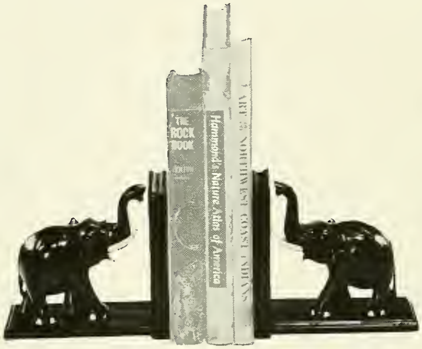
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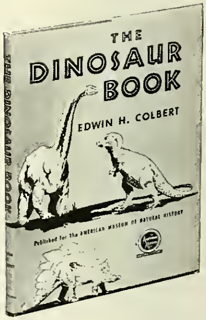

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LETTERS

Lightning

Sirs:

In Gary Webster's excellent article on lightning in the June issue of Natural History, he says "Celestial electricity is responsible for more than half of all the fires in the oil industry."

In the early days of the oil industry, when most crude oil storage tanks in the producing fields were either wholly or partly of wood, lightning was probably the greatest single cause of *tank fires.* With the gradual substitution of steel for wood, the percentage has declined and is now far below that figure.

An oil refinery is now a forest of steel structures rising in many cases to heights beyond 200 feet. These well-grounded points act as lightning rods and shield every lower structure within their "cones of protection." Result: workers in these plants have little to fear from lightning. Tank ships and tank trucks also have an almost perfect lightning-free record.

But the oil industry unfortunately has other fires. With these as a denominator the percentage of lightning ignitions falls to a very small figure—probably not over 2 per cent.

George F. Prussing

Washington, D. C.

Gambling by Glowworm

Sirs:

John Pallister's account of the Pyrophorus beetle and the surgical operation performed by the light provided by these insects reminded me of the tense gambling scene in Hardy's *Return of the Native.* The two men had been throwing dice on the heath by the light of a candle when a large death's-head moth flew at the candle and extinguished the light by the force of the blow. Wildeve, furious at the interruption, gathered thirteen glowworms, arranged them around the stone that served as a gaming table, and the play was resumed.

Hardy explains to his readers that at the season when these insects put forth their greatest brilliancy, it is possible to read handwriting by the light of two or three of them.

B. W. Huebsch

New York, N. Y.

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November, 1955 Volume LXIV, No. 9

Caraja Indian Boy .... Cover Design
From a color transparency by Harold Schultz

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Your New Books 452

Spiders for Profit .... Nan Songer Hook 456
Large and small, well-armed and weaponless, I breed them, feed them, and wind up their webs

Family Life of the Desert Quail .... Willis Peterson 462
The male proves that the way to the female's heart is through her stomach, and no random bachelors are tolerated

The Puzzle of Poverty Point .... James A. Ford 466
Excavation of the most complex geometrical earthwork in North America proves it to be the oldest planned town in this part of the world—an Indian settlement that flourished 2700 years ago

An Insect Masquerader .... Raymond J. Stein 472
Though not related to the mantis, the mantispid has evolved into its diminutive counterpart

Many Lives Has the Oak .... Ross E. Hutchins 474
The Monarch of the Forest gives safety and sustenance to thousands of varied creatures through its long life and far beyond

Majesty in a Fur Coat .... Gary Webster 476
Well-fed, well-housed, and well-loved, the domestic cat is America's true aristocrat, and she doesn't want you to tell her how she can earn her keep

Attack on Chimantá .... Julian A. Steyermark 482
The largest of the "Lost Worlds" of South America thwarts a lone explorer on his first attempt but yields to his second

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A photographic analysis of one of the most extraordinary methods of locomotion in the world of nature

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The wrecks of vessels sunk centuries ago yield secrets of the era of colonization and conquest

Mianus Gorge 496
In the shadows of New York's skyscrapers an unspoiled forest has been preserved

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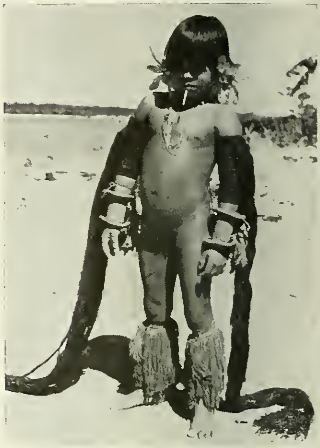

THE COVER THIS MONTH

Among the Caraja Indians along the Araguaia River in Brazil, one sometimes sees a little boy like this, who for reasons not clearly understood is decked out every day in the finest ornaments and receives a sort of adoration from the whole populace.

His face is painted red with *urucú*, and he wears elaborate wristlets and long black streamers from his arms. His ears are richly adorned with "feather-flowers" with mother-of-pearl centers. His under lip is pierced to receive a bone stick, which will later be replaced by a large painted wooden one resembling a flashy necktie.

Caraja youngsters learn early to read the signs of the forest and to use a bow and arrow and paddle. Members of the tribe travel weeks or months up and down the river in small wooden canoes, fishing, hunting, collecting turtle eggs, or visiting relatives. They even go almost to the headwaters to cut a special bamboo for their arrows. They are an artistic people, noted for their distinctive clay "dolls," and they live in peace with civilization.

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Crater Lake, like each of the national parks, has the special essence of America. Like America it was born of fire and upheaval . . . but when the violence was through, something new and beautiful was created that hadn't been there before. And a man can look at it and find it good . . .

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THREE TICKETS TO ADVENTURE

- - - - - - - - - - by Gerald M. Durrell

The Viking Press, $3.75
11 illus., 203 pp.

PERHAPS because they have such limited surrounding at home, the English have a special knack of turning up in the most out-of-the-way places doing the most unusual things.

Gerald Durrell is an Englishman, and his special interest in life is bringing back wild animals for the zoological gardens at home.

This book is an account of a trip he made to British Guiana with his partner, Kenneth Smith, for a living collection of the birds, mammals, reptiles, and fish that inhabit this corner of South America. A local man named Ivan made up the trio of the *Three Tickets to Adventure*.

Strangely enough, after studying a large map of the district in a tiny bar at Georgetown, trying to make the crucial decision on where they should go, Ivan proffered this suggestion, "I think you would do well if you went to Adventure," and stabbed with his finger at the mouth of the Essequibo. Here he claimed there was a small native village by that name. Next day they bought three tickets to Adventure.

By following the usual procedure of buying most of their animals from natives, they made a great haul including lizards, snakes, birds, fish, and a large variety of mammals. Getting them into cages and keeping them there was excitement enough in itself.

Later, leaving the densely forested country of the coast behind, they traveled inland by plane to the rolling grassland of the Rupununi savanna and to Karanambo. Here, they had many thrilling experiences while catching their own animals, including running down an elusive giant anteater on the plains and roping a fourteen-foot cayman (alligator) on the banks of a river.

Mr. Durrell points out that acquiring the animals in the first place is only a small part of the worries and disappointments of the collector. In addition to housing and caring for them, they must be kept alive and transferred to a diet that can be supplied on the long voyage home.

Gerald Durrell writes in a light amusing style that holds the interest of the reader. All the incidents told could well have happened in this particular corner of the world. The book is easy to read and is illustrated with excellent photographs of the strange and unusual animals they captured.

GEORGE C. GOODWIN

NORTH AMERICAN BIRDS OF PREY

- - - - - - - - by Alexander Sprunt, Jr.

Harper Brothers, $5.00
227 pp., 46 colored plates,
4 black-and-white illus.

THE birds of prey have always been favorites with many naturalists and outdoorsmen. In bygone times and to a lesser extent at present this admiration found expression in the art of falconry, with its elaborate ritual. Nowadays we are usually satisfied with observing hawks and owls, identifying them, and searching for their hidden nests. To be sure, those who appreciate the beauty and value of the birds of prey are still outnumbered by others, chiefly hunters and farmers, who see in them only enemies of game and poultry to be destroyed at every opportunity. Fortunately, the fact that these predators destroy great numbers of harmful rodents is becoming more generally known. Even those that prey upon game have a role in nature, for, as we now know from actual observations, more often than not they catch sick or weak individuals.

The present book, by Alexander Sprunt, Jr., of the National Audubon Society, provides a much-needed authoritative source of information about the North American birds of prey. It is based upon an earlier out-of-print volume by John B. May, but Dr. Sprunt, drawing upon his lifetime of field work, has rewritten the entire text. The same color plates of the hawks by the late Allan Brooks have been used in both works, while for the owls (not included in the earlier book) a number of artists are represented. To aid in identification, there are flight silhouettes of the hawks by Peterson. It is unfortunate that Dr. Sprunt has given so much attention to subspecies. One is also surprised to find that he has not followed the recent custom of using for several species of falcons the more appropriate British name: Peregrine instead of Duck Hawk, Merlin rather than Pigeon Hawk, and so forth. On the whole, however, *North American Birds of Prey* is an attractive, well written, and reliable book.

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OUTDOOR HAZARDS, REAL AND FANCIED

- - - - - - - - - - - by Mary V. Hood

Illustrated by Don Perceval
The Macmillan Company, $3.95, 242 pp.,
70 illus.

THE inexperienced camper, the novice hiker, and the city dweller who takes to the countryside on weekends or during vacation should find this book of considerable value. Its three major divisions deal with hazards, real and fancied, involving animals (land and sea), plants, and the elements.

To the person unfamiliar with the real hazards of living in the out-of-doors and unschooled in the proper precautions, it often seems that all of nature conspires to make a trip into the countryside a nightmare of horrors and discomfort. Many of the hazards people associate with the out-of-doors are fancied, such as the belief that bats seek refuge in people's hair, that porcupines "shoot" their quills, that handling toads can cause warts. The author "debunks" a goodly number of such unwarranted fears.

A book of this size cannot deal in detail with every outdoor hazard, nor can it contain a complete description of every species of plant and animal which in some way may present a hazard. However, the book does point out very clearly the major hazards and does indicate the need for the reader to use other books of reference.

Out-of-doors safety is principally a matter of knowledge of the outdoors, of the habits of creatures, the nature of plants, the constitution of the terrain, the behavior of the elements. Like safety at home, safety outdoors depends largely on the intelligent behavior of the individual.

JOHN R. SAUNDERS

ORCHIDS AS HOUSE PLANTS

- - - - - - - - by Rebecca T. Northen

D. Van Nostrand Co., $3.50
122 pp., 12 illus.

NOWADAYS a host of persons are growing plants indoors. They grow them in windows, in Wardian Cases, in attics, and even in basements. This practise began with such tolerant plants as begonias and geraniums, moved into wider fields with African violets and foliage plants such as the Philodendrons, and now the home-grower is ready for the aristocracy of the plant world, the orchids.

Considerable has been written about the ease with which orchids may be grown as house plants, and misleading advertisements tell of fortunes to be made in home-grown orchids. The ads neglect to state that the fortune is made by the dealer who sells the plants and not by the poor innocent who grows them.

Rebecca T. Northen has had experience in growing orchids in the house and in the greenhouse, and in writing about them in books and in magazines. She is practical and writes in simple, clear language, understandable to the layman. In brief, a reading of her present book is the best preparation for the amateur who plans to undertake growing orchids indoors.

The majority of orchids one encounters in conventional trade channels are remarkably tenacious of life. They can survive a surprising amount of abuse indoors, but when they do not bloom, disappointment follows. Mrs. Northen begins her subject logically with a discussion in general terms of the needs of orchids and of the conditions they will encounter in the average home; then one learns a bit about the species and hybrids of the genus *Cattleya.*

The treatment of orchids as growing plants is universally considered under the three temperature categories of warm, intermediate, and cool. She enumerates the optimum conditions for each group and gives a selection of the orchids that thrive under these conditions.

There are chapters on potting, on rearing seedlings, on ailments and problems, and on the use of artificial light. The pen-and-ink illustrations occur at frequent intervals and are helpful in following the text.

For adventuring in the ultimate phase of home-gardening, this book is recommended without reservation.

HAROLD E. ANTHONY

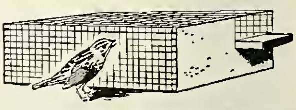
IONIA. A QUEST

- - - - - - - - - - - by Freya Stark

Harcourt, Brace & Co., $6.00
263 pages, 62 photographs, maps

MISS FREYA STARK has written a most wonderful book which should be read by anyone whose curiosity finds play among the paths of history, or whose

CONTROL
ENGLISH SPARROWS



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realization of the significant contributions of Graeco-Roman civilizations to our modern culture makes him desire greater understanding of those civilizations.

In the eighth, seventh, and sixth centuries B.C., there existed along the coasts of western Asia Minor a number of cities whose life blood was drawn from the arteries of a flourishing body of commerce. This commerce extended across Asia Minor to the highroads of Asia. It brought the wares of the Caucasus, Babylonia, Assyria, and Iran to the Aegean Sea, where ships of Greek and Phoenician origin carried them westward. Asia Minor itself contributed to a large percentage of this trade by means of its own manufactures: Sardis carpets, gold, iron and bronze objects, pottery, Miletian cloths, etc. The techniques that brought about these indigenous manufactures were drawn from the East and West—the vigorous inventiveness of early Greek and Cretan and the refined technical achievements of the Oriental. At such places as Miletus, Colophon, Sardis, Priene, and Ephesus, these techniques were developed into a cultural achievement that underlies the later "Glory of Greece."

Today, little exists in the surviving records or at the sites to demonstrate the ancient splendor of Ionia. However, Miss Stark has brought to bear the same sensitiveness to time and people that she did in her famous Arabian travels. The result is a kind of resurrection in which the figures of the past and their contributions take shape again. It is a rare thing to find a traveler who balances fact and creative thought so well that the limitations of both are surmounted and a people emerge, like Aphrodite, "rainbow-throned."

Walter A. Fairservis, Jr.

THE AFRICAN GIANT

- - - - - - - - - - - by Stuart Cloete

Houghton Mifflin Co., $4.00
400 pp., 43 photographs, 6 maps

MR. and Mrs. Stuart Cloete made a journey from their home in South Africa through Rhodesia, the Belgian Congo, French Equatorial Africa, the Cameroons, Nigeria, the Gold Coast, Liberia, Uganda, Kenya, and Tanganyika. The main purpose of this trip was to gather information about the psychology of the natives over this vast territory. The Cloetes spent almost a year in this endeavor and interviewed numerous officials, both white and black, tribal chiefs, as well as men of lesser rank.

In "The African Giant," Mr. Cloete tells of his experiences and resulting conclusions. Throughout Africa there is a decided unrest, with the Africans desirous of freeing themselves of the white man's domination, little realizing how dependent they are on the white man's experience in governing. The inherent greed of the African native, unchecked by the white man's influence, would surely, Mr. Cloete feels, result in tribal wars and further slavery. Other observations and speculations are of equal interest. The book merits attention, especially at this time of world unrest.

T. Donald Carter

THE BEAST THAT WALKS LIKE MAN

- - - - - - - - by Harold McCracken

Hanover House, $4.50
319 pp., Numerous illustrations.

THE jacket of this book states that the contents deal with the lore, legend, and history of the grizzly bear. This is a rather comprehensive coverage, and the author broadens it considerably by labeling as a grizzly all of the large American bears of the genus Ursus. This brings in the large, fish-eating bears usually classified as Alaskan brown bears, an animal noticeably different in superficial characters and temperament from the shorter-legged, more compact grizzly of the interior. Even the short-faced bear, Arctotherium, is, by in-

continued on page 502

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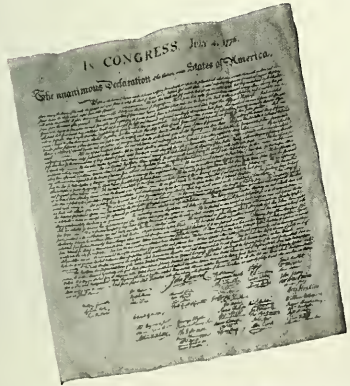

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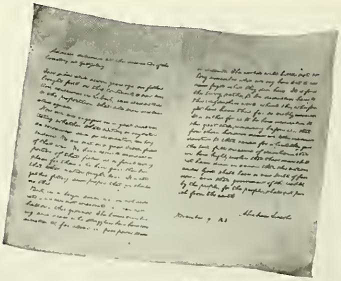

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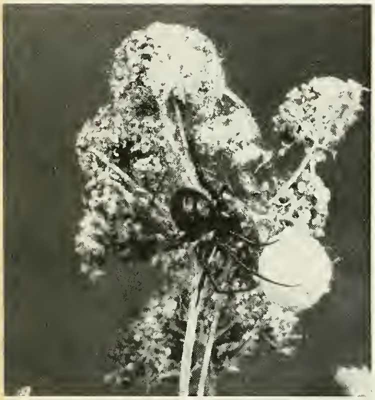
Spider

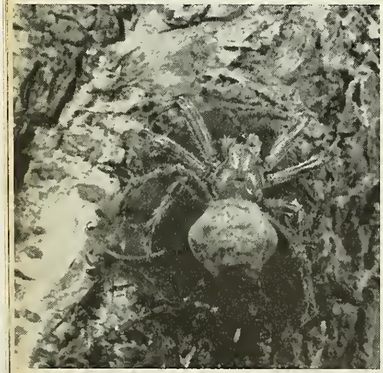
Paramount Pictures, Inc.

▲ THE AUTHOR in her "spidery."



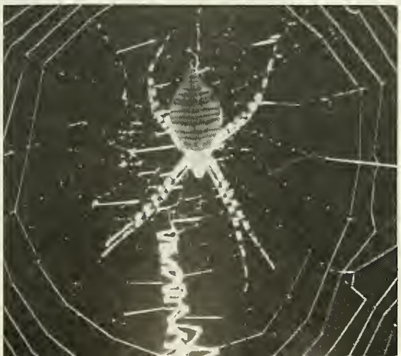
Don Alexander

▲ A BLACK WIDOW makes egg-sacs like this, each yielding several hundred young.



Don Alexander

▲ ARANEA GEMMOIDES' coloration makes her look like a bump on a log.



◄ THE BANDED GARDEN SPIDER spins a web with a metallic sheen that makes it useful for illuminated sights.

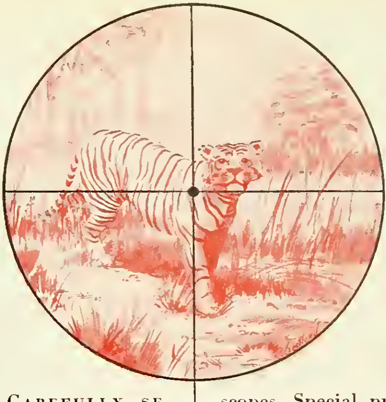
Walker Van Riper

or Profit

Large and small, well-armed and weaponless,

reed them, feed them, and wind up their webs

By Nan Songer Hook



▲ Carefully selected spider silk has been used in 100,000 dot reticules for rifle scopes. Special process makes the dot dry circular instead of diamond-shaped.

EVERY outdoorsman has had the annoying experience of walking abruptly into a strand of silken spider web stretched across a woodland trail. When the glistening filament strikes the bridge of the nose, one usually gropes for it in irritation, plucks it away with momentary surprise at its strength and elasticity—and then promptly forgets it.

Next time this happens to you, pause a moment and examine the strand. What you have struck is the "dragline" of a spider, quite possibly one of the strongest materials made by a living creature. Because spider web is so fine (sometimes only a millionth of an inch in diameter), it is seldom thought of as strong. Actually, the draglines of certain spiders have greater tensile strength than steel, and are said to be exceeded in this respect only by fused quartz fibers. There is almost nothing of equal fineness and equal strength.

The dragline is only one of many kinds of silk a spider can produce, but it is the most familiar kind. To a typical web-spinning spider, it is literally her lifeline. She hangs from it, uses it as a bridge, and lays down the main supports of her snare with it. Throughout her life, she skitters about with a little bit of dragline silk trailing behind her —ready for instant use.

Naturally, such a wondrous material has not been overlooked by man in his endless experimentation. Primitive people in many parts of the world have put spider silk to work. It has been used for fishing lures and nets, for bird snares, and as a fiber for weaving small bags and ornaments. It has even been tried for making clothing, though without much success, because it is so costly to extract.

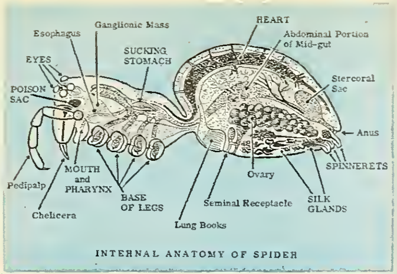
There is one use, however, well known to hunters, engineers, and scientists, that makes spider web important in modern-day technology. This is its use as cross-hairs in high-powered optical instruments. For the past sixteen years, I have supplied spider web to this highly specialized industry, working mostly from the sun-room of a cottage in Yucaipa, California. My business, conducted on a part-time basis, is the rearing and "silking" of spiders. In recent years, my husband Ray has worked at my side.

My entry into this field was actually an extension of a girlhood interest in insects. As a teenager with a butterfly net, I used to collect specimens for professional entomologists. But my hobby was interrupted for many years by family duties, and only when my children were away at school was I able to resume my experimental work. At first I tried breeding crickets, then branched off into a study of spiders and their webs. In 1939, I learned through a friend that inquiries had been made to the U.S. Bureau of Standards asking *if* and *where* spider web could be obtained in quantity. This interested me, so I wrote to Dr. Willis Gertsch, of the American Museum of Natural History, and asked him whether I might be able to contribute something in this field. He replied that so far as he knew almost no work had been done and that very little was known about the commercial properties of webs.

This was just the sort of thing for me, so I wrote to the Bureau of Standards and volunteered to undertake a "spidery."

The Bureau offered encouragement and supplied me with a list of potential customers, but when I corresponded with the latter I found that they didn't know what sizes or quantities of web they wanted. So the first few years were largely experimental (which means I didn't make any money at it). The companies would furnish the best specifications they could, and I would send them samples of web. All too often, something would be wrong and I would have to try and try again to satisfy them. Gradually I began to build up a system that greatly reduced the number of failures, and in time I developed a number of steady customers.

So far as we know, Ray and I now operate the only business in



INTERNAL ANATOMY OF SPIDER

Drawing by George Childs

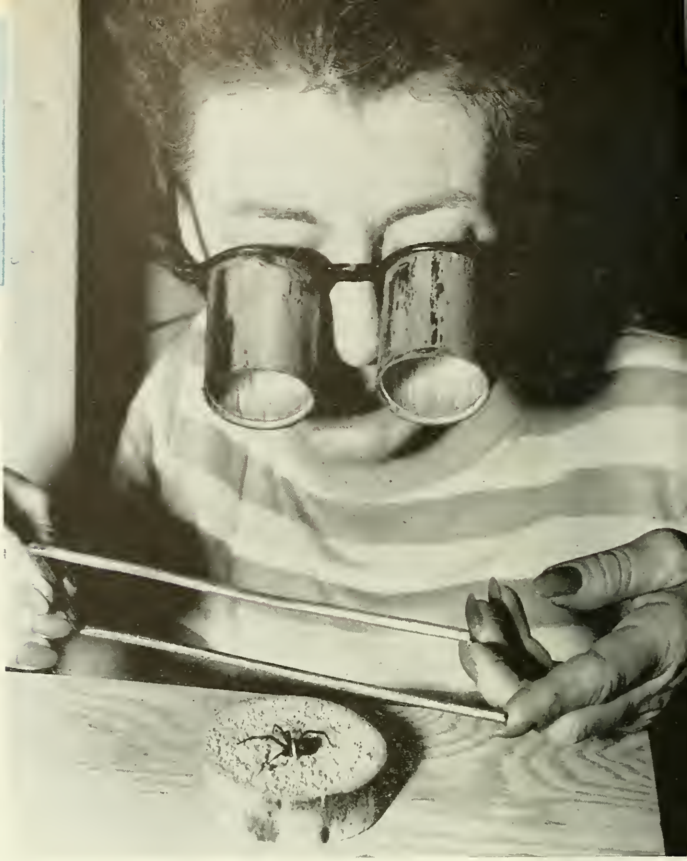
▲ VARIOUS groups of glands, each producing a different kind of silk, connect with the spinning tubes at the rear tip of the body.

the world where spiders are reared and silked of webs of specified size, strength, and elasticity. At certain periods, we may have as many as 10,000 spiders in our home. We extract web from the much-maligned Black Widow (*Latrodectus mactans*), from the beautiful Banded Garden Spider (*Argiope trifasciata*), and from *Aranea gemmoides,* which has no colloquial name but is one of the large, common orb weavers.

We have tested more than 50 of the some 2,500 different species of spiders in North America and have settled upon these three as best for producing web for optical reticules.

Because we have come to appreciate spiders as something more than "ugly, creepy things," we are completely casual about them, and have even acquired three large tarantulas as pets. One of these, nicknamed Lena, was given to us by Robert Crandall, a "Living Desert" photographer for Walt Disney, who also brought a live Gila monster that we call Sheila. Another friend frequently sends us a box of nice fat Black Widow Spiders at Christmastime.

Our household gives some people the creeps. One of Ray's friends who visited us from Los Angeles looked around without saying much for a few moments, guardedly eyeing our spiders and a leathery desert terrapin ambling around. Finally he looked at Sheila the Gila and exclaimed: "My Gawd, Ray, don't tell me you actually sleep in this house!"



Wide World Photos, L.A. Bureau

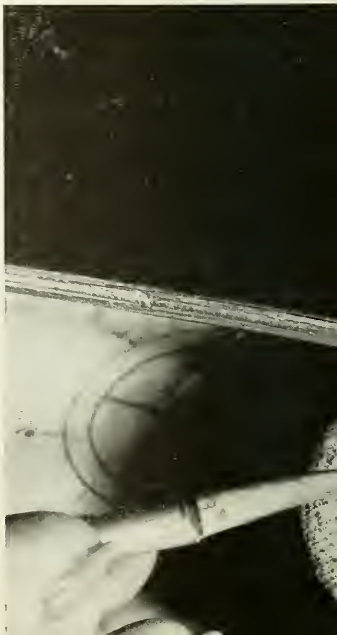
▲ SILKING. The spider is secured with small staples over body and feet. The web is then drawn from the spinneret.

Ray does—and quite peacefully.

Despite its amusing aspects, our work has a very serious purpose. We supply spider web to more than a dozen leading manufacturers and users of optical instruments. Our web finds its way into surveying transits and levels, gun-sights, range-finders, astronomical telescopes, bombsights, microscopes, and medical instruments like those used for obtaining a blood count. Almost every well-known telescopic rifle sight with a "dot reticule" uses our web (see illustration). Probably all surveying transits and levels have spider web cross-hairs. Most microscopes with a reticule and observatory telescopes use it.

It should be pointed out, though, that we did not initiate the use of spider web for reticules. The prac-

▼ WOUND on the U-shaped frame, a single length can be used without disturbing the remainder.



tice is an old one. It is said that spider web was used for fine instruments in Germany many years before it was used here. About 25 years ago, Dr. John Albright, of Cleveland, was collecting and silking Golden Garden Spiders (*Argiope aurantia*) for this purpose. He would catch them in the fall when they were mature and place them on a piece of canvas. As the spiders crawled and trailed their draglines behind them, he would wind it up and store it away for future use. Also, several manufacturers of optical instruments have long been using silk from spiders' cocoons for reticules. And as much as 30 or 40 years ago Keuffel and Esser in Hoboken took dragline threads from living spiders and even employed a "spider lady" for this role. Experience has shown that the dragline is much better than the filament from spiders' cocoons, for it will stretch fully 20 per cent of its own length.

There are other types of optical reticules made with fine steel or platinum wires, nickel-alloy wires, and nylon. In some instruments, the reticule is etched directly on the glass. But for a combination of fineness, strength, and elasticity, nothing is superior to spider web.

Wide World Photos, L.A. Bureau

When a strand of dragline web is stretched across a metal ring and inserted in a telescope, it will afterwards remain straight and true under almost any conditions of temperature. Other materials of equal fineness either tend to sag after a time or, if they are not elastic, are prone to break in the frigid temperatures of the stratosphere. I think that is one reason why blond human hair is no longer used in bombsights, as it used to be.

Standardized Spiders

Our chief contribution is in meeting requests for web of *specified* size, strength, and elasticity. Actually we don't do it; the spiders do. We have learned through experience that a given species of female spider (we never use the puny males), of a certain age and size, will invariably produce the same size and type of dragline silk.

Thus, with our inventory of different kinds and sizes of spiders, we are able to mail out order sheets on which we list available web varying from extra-fine (1/50,000th of an inch in diameter) to extra-heavy (1/5,000th). Incidentally, even the heaviest web is nowhere near as coarse as human hair, which averages about 1/250th of an inch in diameter. Our prices are subject to some variation, of course, but right now we sell the standard types at $5 for 10 feet and $30 for 100 feet.

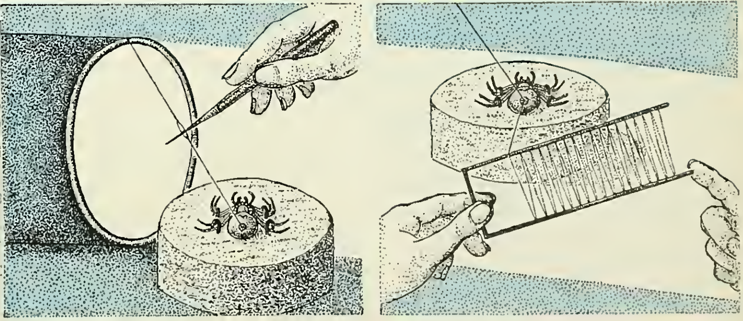
Our extra-fine web is extracted from very young Black Widow Spiders and is used for telescopic rifle sights. Another standard size is used where a center dot is needed in the crosshairs. This web is 1/20,000th of an inch across and consists of a strand split from the dragline of a half-grown Black Widow.

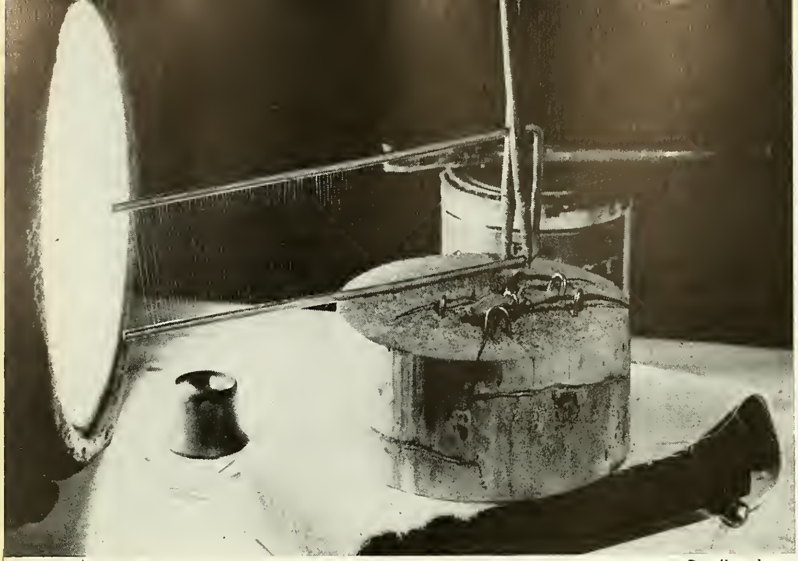
Notice the word "split." "Whole web" is not smooth enough for many applications, so we have learned to separate the two or three strands in the dragline and extract only one. To understand the silking and splitting processes you have to know a little about the anatomy of a spider and the nature of her silk.

The plump abdomen of a spider is her silk factory. Inside it she has a multitude of tiny silk-producing glands. These are connected to a cluster of openings on tiny fingers at the hind end of her body, called spinnerets. When the silk is inside her, it is liquid, but it hardens almost instantly when drawn from the spinnerets. The spider does not spin it out as you would cast a fishing line—it must be pulled from her. Usually she tacks down the end of the web and then scrambles or drops away, so that the long filament is extracted from her body. Sometimes she draws out a few inches with her rear legs and lets a breeze do the rest. When she has released as much as she wants, she reaches back and cuts the strand

▼ To obtain split web, the spider is placed upside down on the pedestal and immobilized with staples placed over her waist and legs (two legs per staple). The two- or three-strand dragline is drawn out and cemented to the rim of the work light. Then a needle is flipped back and forth across it until a loop appears into which the tip of the needle can be inserted and slid down to the spider's spinneret. At this point, a single strand can be wound onto a frame without extracting unwanted web.

Drawing by George Childs, after Nan Songer Hook





Don Alexander

▲ THE INDIVIDUAL SPIDER may produce 150 feet of web at a silking and can be silked again a few days later. A mature Aranea holds the record at the Hook spidery, with 1000 feet. In old age, the spider's silk glands grow less productive. Only the females are worth bothering with.

Wide World Photos, L.A. Bureau

▲ THE U-SHAPED FRAMES of silk are packed in this type of case for shipment to manufacturers of optical instruments.

with a claw on the tip of her foot.

The various kinds of silk (each produced by a different set of glands) all have a part in the spider's normal activities. If she makes a web, its main supports are of elastic dragline silk that will absorb the impact of a flying insect, as a tennis net does a ball. Other strands in the web are weak and sticky, and will sag; they are for entangling a victim's wings. The silk she uses to "lasso" and wrap a victim is like a white ribbon. Still other kinds are used for constructing the cocoon-like egg sac.

The actual silking process is not too difficult, but it does require experience and patience. We use only the dragline, and basically, there are two methods, depending upon whether "whole web" or "split web" is desired.

To obtain whole web, I remove the spider from her jar and place her upright on a small pedestal of yucca wood. Then I immobilize her by positioning a staple over her narrow waist and pushing the prongs into the soft wood. Next I use a small camel's hair brush to "tickle" her spinnerets until she produces a little of her dragline. I draw this out with the brush and secure it to one end of a U-shaped metal frame, on which it is wound "spiral" fashion. I space the silk at quarter-inch intervals so that each section may later be removed independently. When the frame is filled, it is placed in a specially designed box for shipment.

Separating The Strands

If split web is to be extracted, I secure the spider on her *back,* since the two or three strands of the dragline seem to separate more easily when she is inverted. Besides snugly stapling her waist, I also secure her feet (two per staple) to keep her from reaching back and cutting the web. Then I pull out a length of whole web and cement the end to the edge of my work-light. To split away a single strand, I pick back and forth across the web with a needle until a snag appears, then insert the needle in the loop and slide it down to the spinneret. The single strand may now be wrapped around a frame in the manner described for whole web. The unwanted strands do not emerge further.

Splitting the dragline has eliminated many of the objections that were encountered at first. The technique was developed quite early in the work because the Bureau of Standards and several of the private concerns reported that the twisted strands of whole web made it too irregular for high-powered optical instruments. Split web is much smoother under high magnification than whole web—even than whole web of equivalent diameter extracted from a very small spider.

This linear smoothness is an important characteristic. At present there is much demand for a heavy single-stranded split fiber 1/3,000th of an inch in diameter. This approximates the size of heavy cocoon web, but technicians would prefer the more resilient dragline. No spider we have in this country will produce silk so coarse. We have heard of some mammoth spiders in Bermuda or the Bahamas that spin webs so tough that you have to chop your way through with an ax. We would like someday to go exploring and bring back some like that, but we wonder whether any could measure up to this advance publicity. When Carveth Wells, the well-known traveler and lecturer, told on the radio about some of these super-spiders, I wrote asking about them. He replied on the air and made much of the fact that, for the first time in his experience, a lady had expressed a desire to obtain the *biggest* spiders he had ever seen. He called them mammoth and as large as a fist.

When producers of microscopes and gun sights told us they needed a finer split strand than adult spiders could produce, we began experimenting with younger ones. They proved satisfactory for the job, so we began breeding them from the egg sac.

One species that we use, the Banded Garden Spider, produces web that has a metallic sheen which reflects light. I do not know how the reticule is used, but I have seen the lighting apparatus when it was brought to our house by technicians. Tiny electric bulbs, placed at the ends of the cross-hairs, made the web glow like a miniature neon sign.

One of the best-known telescopic rifle sights in this country uses a reticule that I helped perfect. I worked with the manufacturer, Mr. T. K. Lee. The problem was to establish, by a process of elimination, web of a size that would support a tiny, perfectly round dot without obscuring vision. The search was made difficult by the fact that the dot must be liquid when applied. If the cross-hairs were even a microscopic amount too large, the tiny dab of liquid would cling to the corners, forming a diamond shape rather than a circle. After much experimentation, we were successful, and the process is now patented.

I am told that there are now more than 100,000 of these dot reticules in rifle scopes and that they are used on African safaris going for the world's biggest and most dangerous game. Quite an accomplishment for spiders whose normal prey is less than an inch long and who are in mortal danger at the downward swoop of a fly-catcher.

Measuring Thickness

You may wonder how optical technicians can determine precise measurements of such fine strands. It is done with a device called a delineascope—which works on the same principle as the old magic lantern. By projecting a highly magnified image of a reticule onto a screen where the ratio of enlargement is known, measurements can be made of the screen-strands and converted arithmetically to actual measurements.

We don't have to use such an instrument because, with our data gathered over the years, we usually know just what species, age, and size of spider will produce web of a certain size. The size of web never varies if the workers are not stunted and are in good condition. Once a manufacturer selects a size and type he likes, we merely pick out the appropriate spider when he places a repeat order.

We can't substitute one species for another. Even if the spiders themselves are exactly the same size, their webs won't be. For example, the dragline of a one-inch grass spider is not nearly as large or as strong as that of a *baby* Aranea the size of a matchhead.

The reason we always use females is that spiderdom is apparently one province in the animal kingdom where the ladies excel in almost everything. They usually grow much larger, are tougher, and spin better quality silk. Even when you match sizes by pitting a young female against an adult male, the female will be the better performer. Her silk will be stronger and she will produce much more of it.

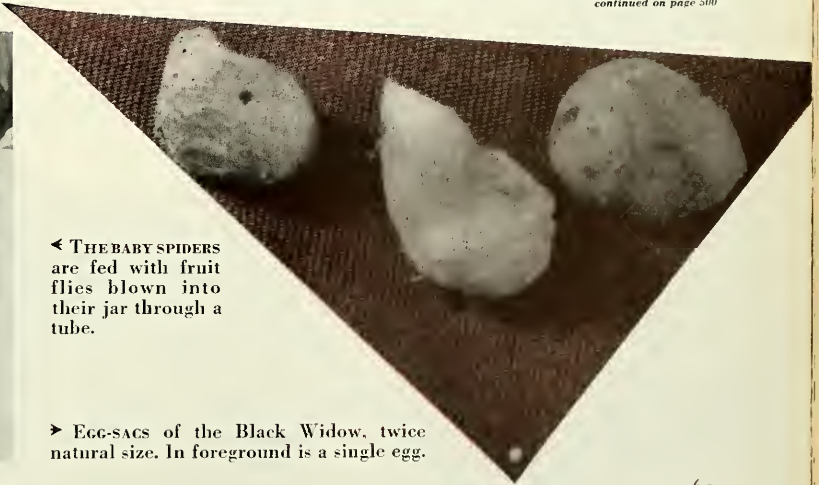
A female spider may be silked as many as 25 times, barring injuries, and can easily produce 100 feet or more in a single sitting. The record at our spidery is a thousand feet, and was set by a mature Aranea spider.

We have learned much about how to keep spiders healthy and contented. This may sound absurd, but spiders do respond to good care. Some of the regular produc-

continued on page 500

Black Star

◂ **The baby spiders** are fed with fruit flies blown into their jar through a tube.

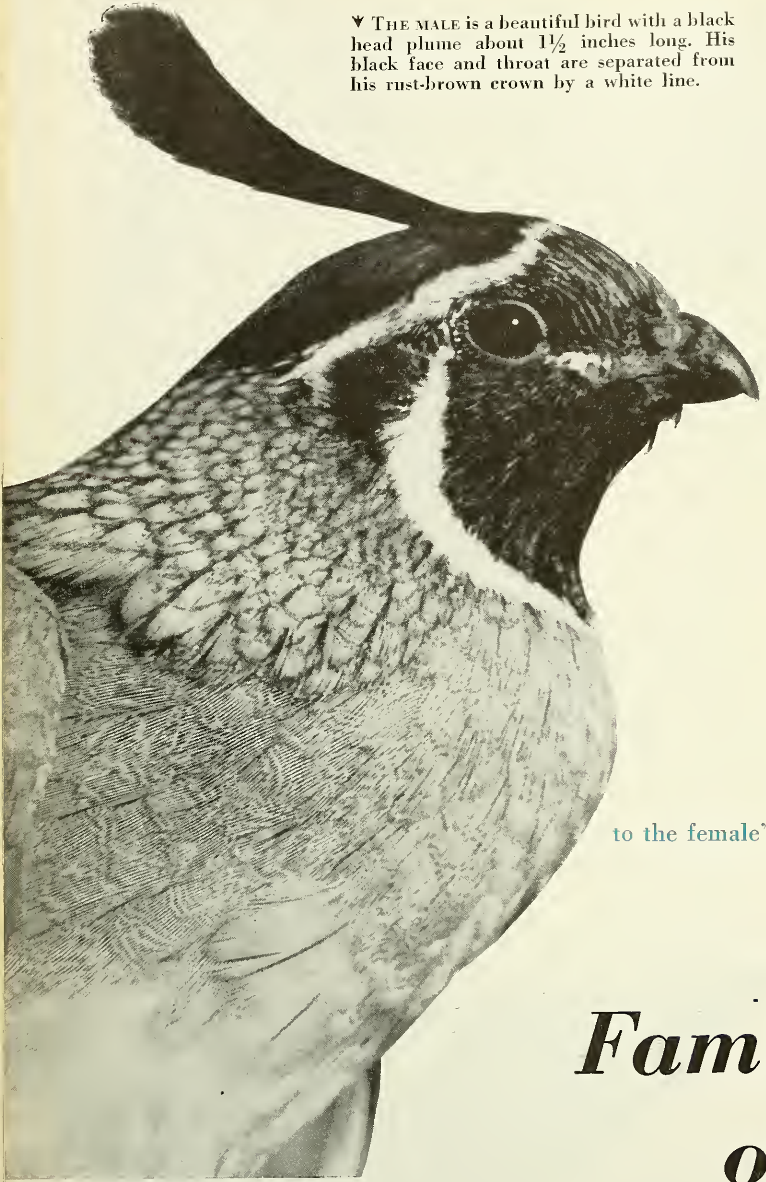


▸ **Egg-sacs** of the Black Widow, twice natural size. In foreground is a single egg.

Family Life of the DESERT QUAIL

The male proves that the way to the female's heart is through her stomach, and no random bachelors are tolerated

By WILLIS PETERSON



▼ THE MALE is a beautiful bird with a black head plume about $1\frac{1}{2}$ inches long. His black face and throat are separated from his rust-brown crown by a white line.

A COVEY of Desert or Gambel's Quail, with ebony plumes tilted rakishly overhead, often reminds me of a Lilliputian squad of the Royal Guard skipping past in quickened cadence.

The cheerful, three-noted call of these plump, alert little birds may be heard from El Paso, Texas, west to Indio and Palm Springs, California, and from Upper Sonora north to southern Utah. My acquaintance with them has been in the vicinity of Phoenix, Arizona, and I have come to regard them with special affection.

Any naturalist would find their courtship activities appealing. The jaunty little male first pays suit by selecting a tempting morsel of food and offering it to the female of his choice. If she approves (demonstrated by eating it), he finds and offers her more. While she downs these tokens, he bows up and down, uttering low sharp whistles, or minces around her in a ludicrous little dance. His attentions are not likely to go unnoticed by other

cocks, and he usually has to make good his claim.

The small antagonists square off, eying each other warily, ruffling their neck and breast feathers, and raising and lowering their plumes. Then, after a period of circling and feinting, they rush together for a flurry of pecking and slashing with their sturdy beaks. Soon the battle is over, and one cock withdraws while the other claims his prize.

Unfortunately, the victor is not always the real winner. During the battle, the demure little female may cast her eyes toward another male. With a flourish, he is at her side, bowing and bobbing, his topknot flashing. If he is bold enough, he may succeed in merely walking her away from the other suitors.

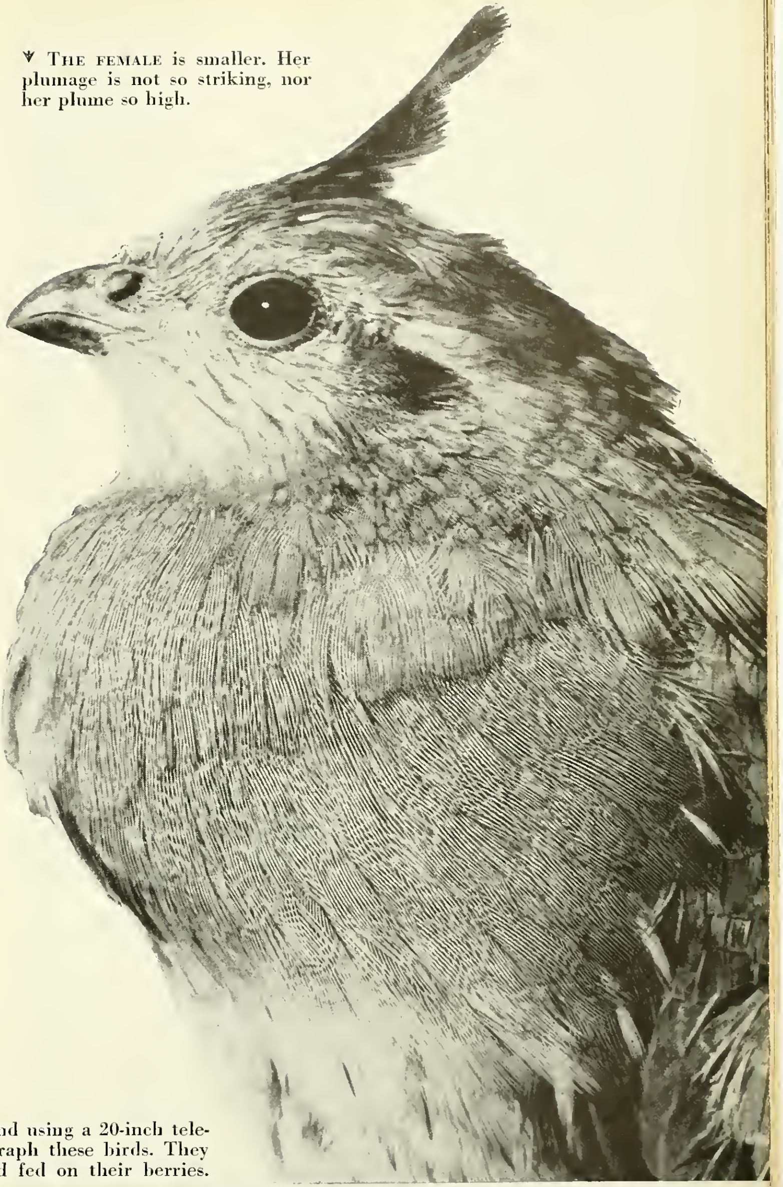
The jilted cocks may then drop their enmities and perch side-by-side in a mesquite, rearranging their feathers and plaintively calling for more responsive mistresses.

Some hens apparently wait until almost the last minute before finally selecting a spouse, for come-hither whistles from persistent cocks may be heard for a considerable period during the spring. As summer approaches, the calls decrease.

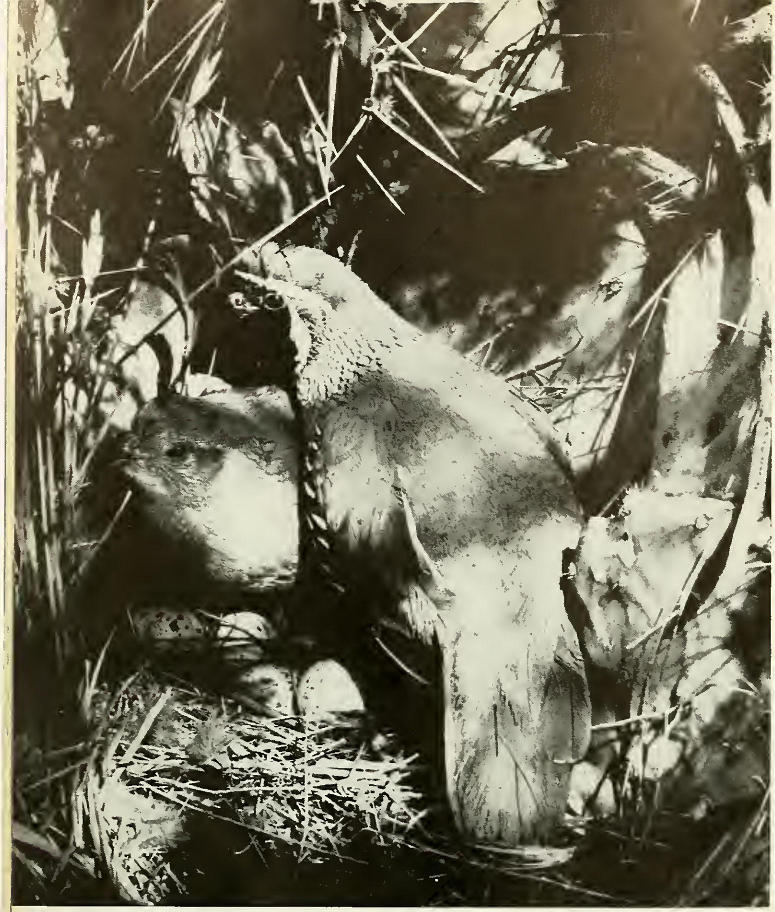
Each year, a few of the males are left without mates. They become lonely bachelors and are chased relentlessly if they venture too near the contented pairs.

When flirtation and courtship are over, the couples get down to the serious business of raising families.

▼ **The female** is smaller. Her plumage is not so striking, nor her plume so high.



▼ **By building** a tumbleweed blind and using a 20-inch telephoto lens, it was possible to photograph these birds. They roosted in these blackberry vines and fed on their berries.



▲ It is rare to catch both the hen and her mate at the nest. He is a devoted partner, but he never sits on the eggs. He often perches in a near-by tree.

▼ Even at this early age, the tiny chick has the beginning of the quail's conspicuous top-knot.

Nests vary in workmanship. Some are little more than hollows in the ground hidden under brush; others are so cleverly constructed that they can be lifted out intact.

Most of those I have seen have been concealed in clumps of prickly pear and were made so that the sitting hen had a wall of cactus at her back. She usually faced an opening that led through runners of cactus—like a crude chute. The over-all result was a spiny retreat well-fitted to discourage molesters.

April usually marks the beginning of the setting period. Ten to twenty eggs comprise the clutch. They are laid at a rate of one a day until four or five of them grace the nest. Then the female skips a day or two, so that the pattern becomes irregular. Incubation lasts 23 or 24 days.

During this time the male keeps constant watch from a favorite tree or post, scanning the landscape. His occasional cheery call probably gives comfort to his mate during her lonely vigil. Twice a day, the cock leaves his lookout to escort the female on foraging expeditions. He makes his way over a circuitous route to a point close to the nest, then gives a call that the female recognizes as a signal for a rendevous. She joins him, and they depart together for a feeding period that may last from several minutes to two hours, varying with the weather. They depend on mesquite for much of their diet. Hackberry and buckthorn contribute berries, and, as the season advances, grasshoppers become a much-relished item in their menu. If water is handy, they will drink on these excursions, though the juices of green plants usually must suffice.

On the twenty-third day, the eggs begin to hatch. Each chick pecks a ring in the big end of the egg, producing a hinged cap that swings open like a ship's hatch. Then, pushing with tiny feet, the animated bit of fluff steps free of the shell. At this point, the chick is no bigger than the end of your thumb. Though a bit unsteady at first, it isn't long before the young bird can run with the same agility as its parents.

All the eggs ordinarily hatch during a two- or three-hour interval. If some are slow, the mother must abandon them to take care of the lively, venturesome chicks. The nest is never used again, since only one brood is raised each year. (The unselfish readiness of adult quail to adopt orphaned young of any size has led many observers to suppose that they occasionally produce two broods.)

During the first few days after

hatching, the family's movements are limited. Resting and brooding take place under any handy canopy of desert growth. The chicks are so quick and bright-eyed that it is difficult for the hen to keep order, and she gets little rest. The little ones are continually vying for favored position under her wings and breast feathers and peeking out to peck at the ground. They stir fitfully in their sleep; and when they dart off in pursuit of tiny insects, the hen will give forth scolding clucks to bring them back to her.

If danger should threaten, the cock, always vigilant, gives a low call. Hen and chicks instantly freeze while he exposes himself and tries to lure the invader away.

On the move, father usually takes the lead; chicks fall in behind him, and mother brings up the rear. It's quite amusing to watch one of these miniature caravans move into a feeding ground. The parents dart about rapidly, and when they uncover choice tidbits, they call repeatedly to the youngsters. The chicks rush for the prize and invariably become involved in stubborn tugs-of-war for ownership of the morsel.

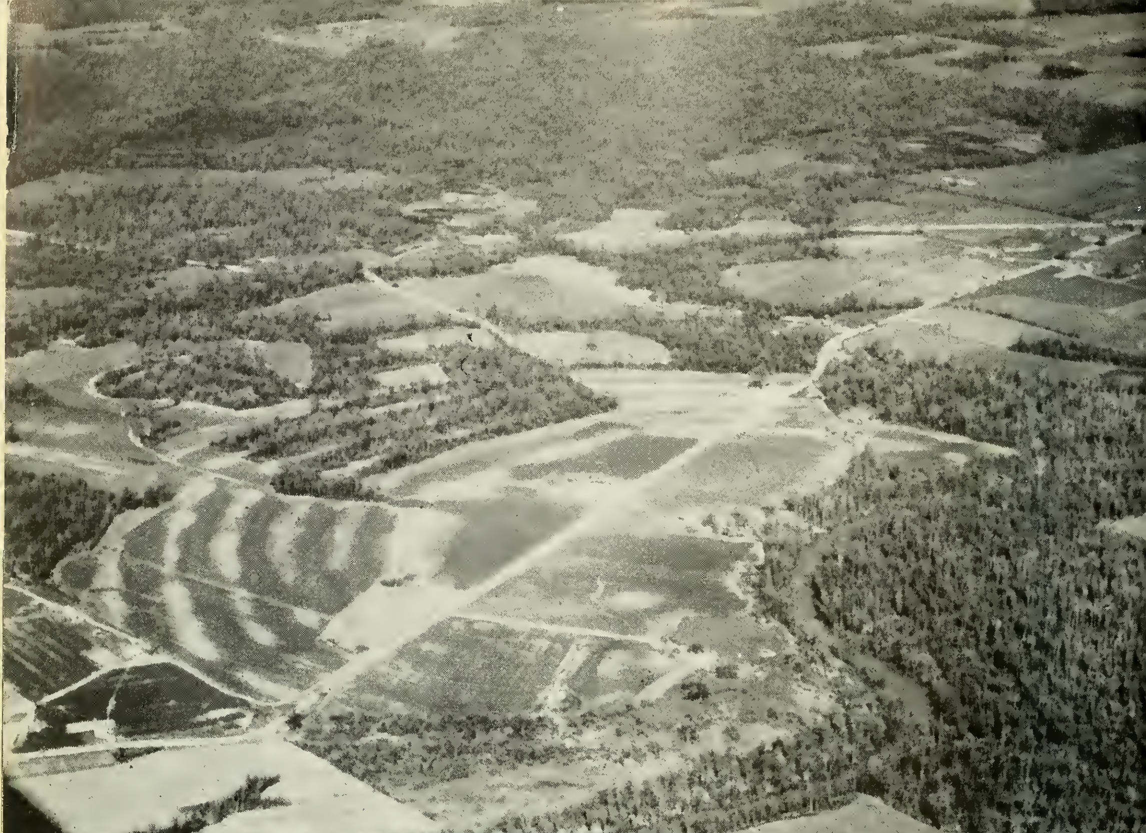
The wing primaries of young quail develop rapidly, and the chicks are able to perform short flights in seven to ten days. This greatly reduces the hazards, since the family can then roost at night in thickets.

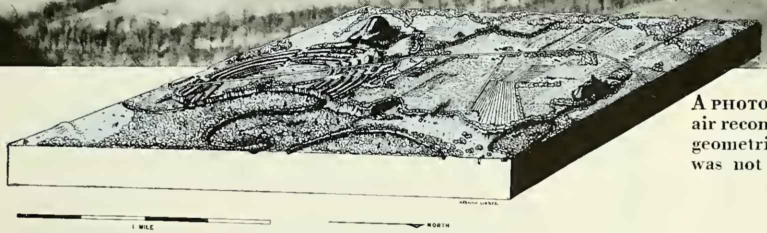
In October and November, the young molt their drab, mottled-gray juvenal plumage to take on adult garb. With the coming of spring, last year's chicks will be ready to find mates. They have a life expectancy of three to five years.

▼ Usually the male escorts the hen on a foraging trip twice a day during the setting. Here the male is drinking. But usually the female seems thirstier, perhaps because she is more confined to her nest.

▲ Sometimes the parents leave the chicks in their hiding place and perch on a fence post or tree, possibly to see if some intruder has left.

▲ The Gila monster has been known to eat all the eggs in a quail's nest at one sitting, though it takes him quite a time to do it. However, he is not a very serious enemy.





A PHOTOGRAPH that shows the value of air reconnaissance in archaeology. The geometrical pattern of the ancient site was not suspected from the ground.

The Puzzle of POVERTY POINT

Excavation of the most complex geometrical earthwork in North America proves it to be the oldest planned town in this part of the world—an Indian settlement that flourished 2700 years ago

By JAMES A. FORD
Associate Curator of North American Archaeology
American Museum of Natural History

Photographs by JUNIUS BIRD

UNTIL last spring, the principal archaeological enigma in southeastern United States was the prehistoric village at Poverty Point, in Louisiana. It is the largest settlement of comparable age that we know about in the United States.

Numerous objects showing human workmanship had been collected from round about the locality. Yet these specimens did not conform to any of the periods in the known prehistory of the Lower Mississippi Valley, where the sequence has been worked out in some detail from about the time of Christ right up to the coming of Europeans.

The two large mounds at Poverty Point had been recognized for more than half a century as the work of prehistoric people. They are as high as six- and seven-story buildings. The taller one, in fact, is the second highest Indian mound in North America. Yet we knew nothing about the people who made them.

The excavating we undertook this year at Poverty Point produced about 800 pounds of specimens, which give us our first direct insight into the life of a large community of aborigines who lived in southeastern United States a half a millennium before the beginning of the Christian era.

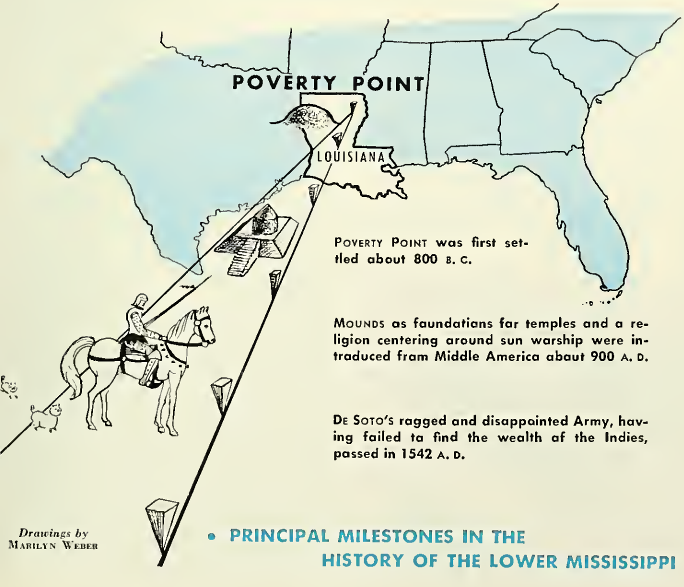
We can now begin to fit their culture into the broad outlines of human history in eastern North America before the arrival of Europeans. We know that 10,000 years ago, Indians were living here who had a chipped-stone culture somewhat resembling the Solutrian techniques of the Old Stone Age in Europe. This was at the time of the beginning of the retreat of the last Pleistocene ice sheet in North America. Early in the first millennium B.C., the inhabitants of eastern North America began to produce a number of new things, such as dome-shaped mounds as tombs for the dead, stone tools that were ground instead of being chipped, pottery, and techniques of working copper. These things are suspiciously similar to tools used about the same time by people living in central Siberia. The techniques may have been brought into eastern North America by a new wave of immigrants. However, connecting links are lacking over the thousands of miles that lie between.

The second major change in the cultures of eastern North America occurred about 900 A.D. The influence in this case seems definitely to have come from Middle America, where the highly evolved civilizations of the Mayas and others were in the making. This wave brought the bow and arrow, intensive agriculture, and a new religion that led the Indians to build rectangular pyramids of earth as bases for temples. However, the ancient people of Poverty Point lived and died long before the cultures of Middle America made themselves felt in eastern North America. This settlement is rather to be identified with the cultures that stemmed from Asia by way of Bering Strait. The intervening distance and the time interval are both great, but evidence supporting this includes fragments of tubular pipes. These are similar to tubes that have been used for magical cures in northeastern Asia for several thousand years.

It was only when Poverty Point was viewed from the air that the spectacular configuration of the ancient settlement became apparent. No one had realized that the low ridges running through the fields had been built by the prehistoric inhabitants. This fact was discovered only in 1953 when I secured prints of air photographs taken for mapping purposes by the Mississippi River Commission of the Army Engineers. As you will see from the accompanying illustrations, the ridges are arranged neatly in six concentric octagonal figures.

The outside octagon is three-quarters of a mile in diameter. At the corners, gaps were left in the ridges to form aisles leading toward the center. A nicer arrangement in city planning for a community of this size could hardly be imagined.

The ridges are from five to ten feet high and were built of earth taken from the swales that lie between them. The dwellings were evidently situated along the tops of the ridges. This we knew because it was along the flanks that we found the greatest concentra-



POVERTY POINT was first settled about 800 B.C.

MOUNDS as foundations for temples and a religion centering around sun worship were introduced from Middle America about 900 A.D.

DE SOTO's ragged and disappointed Army, having failed to find the wealth of the Indies, passed in 1542 A.D.

Drawings by MARILYN WEBER

• PRINCIPAL MILESTONES IN THE HISTORY OF THE LOWER MISSISSIPPI

▲ WHEN THE CONICAL BURIAL MOUND was sliced with a tractor, walls were left standing for recording the strata.

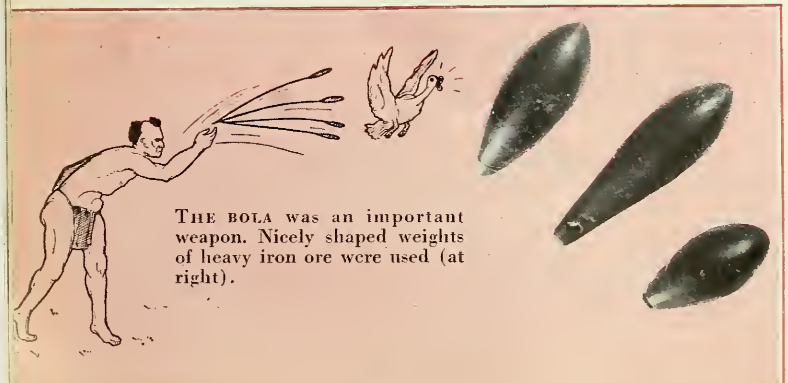
tion of black soil stained with charcoal from cooking fires, as well as most of the broken and worn-out utensils.

After the village was abandoned, the eastern half of this large earthwork was cut away by a shift in the course of the Arkansas River. We were able to identify and date this cutting at about 400 B.C. Later, a portion of the northern segment of the earthworks was erased by Bayou Maçon, which did its cutting around the beginning of the Christian Era.

Archaeologists sometimes like to do simple exercises in arithmetic, and here are some surprising figures to indicate the numerical strength and diligence of the people of Poverty Point. Assuming that the octagonal figure was originally complete in the now erased eastern portion, the ancient people built about 11.2 miles of artificial ridge. Judging from the trenches we cut through existing ridges, the average width of the constructed ridge was about 27 yards and the height 2 yards. Treating these dimensions as a simple triangle, it appears that the Poverty Point people moved more than 530,000 cubic yards of earth, just to make themselves a well-ordered city in which to live. This is over 35 times the cubage of the famous Pyramid of Cheops at Gizeh in Egypt. And it does not include the two mounds, which involved moving another 33,000 cubic yards.

I had excavated here briefly in 1952 and 1953. And Dr. Philip Phillips and I made a start toward unraveling portions of the mystery by excavating another old site called "Jaketown" only 60 miles away in the Yazoo Delta region of west-central Mississippi. There we found remains of all periods of the already known prehistory, neatly stacked in sequence in 10 feet of dwelling-site refuse. Beneath this lay typical artifacts of the Poverty Point culture.

An impression of the time that has passed since "Jaketown" was inhabited can perhaps be gained from the shifts that have occurred in the channel of the Ohio River. The river now enters the Missis-



THE BOLA was an important weapon. Nicely shaped weights of heavy iron ore were used (at right).

▲ After the cross-section had been studied and facts recorded, the walls were removed.

▲ A motor sifter was used for recovering objects showing human workmanship from the excavations in dwelling refuse.

sippi some 350 miles to the north. It then flowed on either side of "Jaketown" and entered the Mississippi opposite the present city of Natchez, only 150 miles from the Gulf. Closely reasoned geological estimates place this channel of the Ohio at about 1500 B.C. However, measurements of the radioactivity of charcoal from the early cultural deposits give somewhat later dates —800 B.C. and 400 B.C.[*]

Setting up Camp

Our intensive work began at Poverty Point last February when my wife and I set up camp on the edge of the site with Junius Bird of the American Museum and Stewart Neitzel of the Louisiana State Parks Commission. An auto trailer rented in a near-by city and a surplus-property Army squad tent provided adequate housing. We drove a well and installed a hand pump but might have spared ourselves this trouble. It rained so much that a couple of tubs placed under the eaves of our tent could have supplied us with enough water.

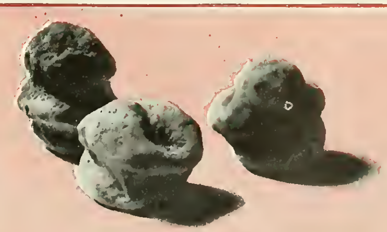
The Louisiana State Parks Commission loaned a tractor equipped for excavating in return for assistance in planning exhibits at the Marksville State Park at Marksville. This machine was invaluable. Our workmen on this four-month excavation were local farmers. They ranged in number from four to twelve, according to the need.

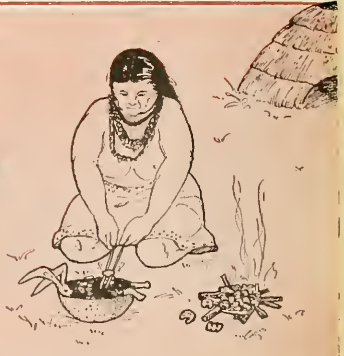
The excavations showed that Poverty Point was first settled around 800 B.C.—approximately the same time that the Jaketown site was established. The Mississippi River then flowed in a braided channel about a mile to the east of Poverty Point. This is some 25 miles west of where the river now passes. Maçon Ridge, upon which the site is located, stands fifteen feet above the flood plain of the Mississippi and is not reached by the annual spring floods. Fear of high water clearly was not the reason why the Poverty Point people built ridges to live on.

Though we looked hard, we did not find any direct evidence of houses. Any traces that might have survived had been erased by erosion or cultivation of the soil. Over at Jaketown, however, we were fortunate to find one house-pattern belonging to this period. It was round and about fifteen feet in diameter. The walls had been built of poles two inches in diameter. These had probably been bent together to form a dome-shaped house similar to the dwellings that were used by the Indians of the Great Lakes region in historical times.

The most abundant items unearthed along these ridges were small clay balls. They had been shaped by the small fingers of women and children and baked until they were like brick. These so-called "Poverty Point objects" had been collected from the site for years and had puzzled archaeologists. In the course of our excavations, their use became apparent. We noticed that they were concentrated about fireplaces and were occasionally found packed in undisturbed firepits. The answer then dawned upon us.

Before about 500 B.C., the so-called Archaic peoples of North America had no pottery and instead cooked in wooden and skin containers. They used stones, heating them until they were red hot and dropping them into the soup. Meat was also baked by building a fire in a small pit and heating a





Cooking was done with clay balls like those above, heated and dropped into containers as shown at right.

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[*] This work is reported in "The Jaketown Site in West-Central Mississippi," by James A. Ford, Philip Phillips, and William G. Haag, in Anthropological Papers, American Museum of Natural History, Vol. 45, Pt. 1 (1955).

number of stones. When the stones were hot, the fire and ashes were cleaned from the pit. Then the meat, carefully wrapped in moistened leaves, was covered with the stones. The New England settlers learned from the Indians a somewhat similar method of baking clams.

The nearest supply of stones in this alluvial valley is 30 miles from here, so the people used mostly these clay balls. We computed that more than 20 million of these cooking balls had been made by the people while they lived in this octagonal town.

Before this settlement was excavated, it had been thought that pottery-making was not yet known at the time of the Poverty Point culture. But the Poverty Point people were not entirely ignorant of pottery. During our work, we recovered twelve fragments of a soft pottery tempered with vegetable fibers. This is the earliest type of pottery known in the Southwest, where the evolution of pottery making has been traced in great detail. Pottery from Poverty Point is not very good, and it certainly was scarce.

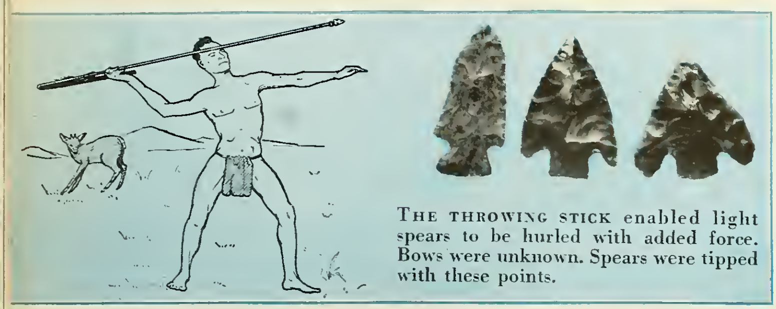
Somewhat more abundant were fragments of vessels carved from steatite or soapstone. A few of these had birds carved in low relief on their sidewalls. The nearest source of this material is 500 miles away, in the mountains of North Carolina. After these fragile vessels were transported such a distance, they must have been very valuable. There is no stone to be found in the bottomlands of the Lower Mississippi. For this reason, the flint pebbles that the people made into knife blades had to be brought at least 30 miles from the hills.

The technique for making knives or scrapers was standardized and rather efficient. It is interesting that the same technique characterized the Mesolithic or Middle Stone Age of Europe, Africa, and Asia. One end was knocked off a pebble to form a striking platform. Then by placing well-directed blows a fraction of an inch from the edge of this platform, thin, narrow, parallel-sided blades an inch to an inch and a half long were broken off. The two edges of these blades were almost as sharp as a splinter of glass.

Doubtless these blades served many purposes. Most of them show a type of wear that results from cutting and scraping hard materials such as bone or antler. Most of the knives we found have the two edges completely worn away except for the end held in the fingers. It would be interesting to know something about the bone and antler tools that were probably made with these implements, but these have all decayed. The scraps of animal bones that are usually found in kitchen debris have also entirely disappeared here, apparently owing to acid soil and the time that has elapsed.

It seems incredible that the population of a town of this size could subsist only by hunting and gathering wild fruits and vegetables. Hunters generally have to live in small bands, widely scattered over the hunting territory. However, the direct evidence for agriculture is scanty and questionable – only a piece of fired clay with what looked like impressions of corn on the cob. More conclusive evidence may come from analysis of plant pollens recovered from muck at the bottoms of the trenches between the ridges, but this study is not yet complete.

▲ **Trenches** excavated to the base of the conical mound were 20 feet deep. Study of their strata told the story of how it had been built.



The throwing stick enabled light spears to be hurled with added force. Bows were unknown. Spears were tipped with these points.

Spears, not Arrows

The principal weapon used by the Poverty Pointers was a dart equipped with flint points and propelled with a spear thrower. This device, known as the atlatl, had the effect of lengthening the throwing arm. Loaf-shaped stone weights were added to the spear thrower to increase momentum. Another common weapon was the bola. This consists of five or six nicely shaped stone plummets, each attached to a cord about eighteen inches long. The cords were all fastened together at the ends, so that when the weapon was swung around the head like a sling and let go, the weights would spread apart. If one of the cords came in contact with a bird or small animal, the other weights would wrap their cords around the creature, securely entangling

▲ **At the end of the season, the conical burial mound was restored in order to stabilize it and prevent damage by erosion.**

▲ **Stewart Neitzel of the Louisiana Parks Commission recording the stratification in a trench cut across one of the occupational ridges.**

it. The bola weights found at Poverty Point were made of a heavy iron ore, magnetite. The nearest source for this material is in Arkansas or southern Missouri. The mineral was mined extensively there for this purpose in prehistoric times, but the bola went out of use when the more efficient bow and arrow was introduced.

The Poverty Point people were connoisseurs of stone and minerals. They imported small amounts of copper from the deposits near Lake Superior and made ornaments of quartz crystal as clear as glass, which they secured from Arkansas. They prized the lead ore, galena, from south Missouri, probably because it has a metallic luster when freshly cut. Small beads carved in the shape of birds were made of red jasper, a very hard stone; and ornamental tablets were made of slate, which also had to be imported.

The larger mound, which lies due west of the center of the octagonal village, is easily the most spectacular of the accomplishments of these people. It measures 700 by 800 feet at the base and rises 70 feet above the surrounding plain. It is second only to the Cahokia Mound near East St. Louis and is a thousand years older. It is in the shape of a bird.

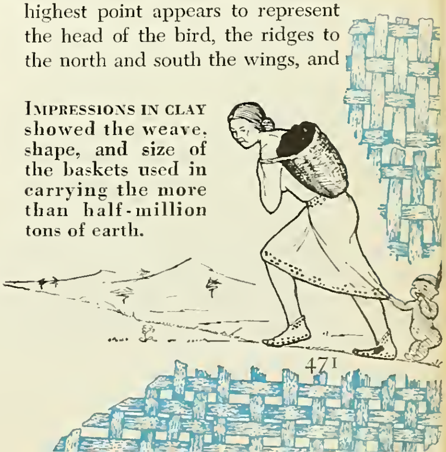
To check whether the Indians might have made the task easier by using a natural hill as the central core of this mound, I drilled a hole down through it from the highest point in 1952, almost to the base. I encountered varicolored soils all the way down, clear evidence that the drill was passing through basketloads of earth taken from different localities. A single flint chip from a depth of 55 feet provided additional evidence that the entire mound was artificial.

The cubic content of this structure is about 185,000 yards. The earth had been secured from the surface of the surrounding plain. Presumably it was loosened with digging sticks and brought to the mound in carrying baskets, each load weighing about 50 pounds. We do not know how many persons worked at this task, or for how long. However, it can be estimated that the finished mound required something over 3 million man-hours of labor.

The secret of why the people should have expended so much effort may lie buried at the base of this mound. Perhaps the mound is the grave of some ancient dignitary. But this secret is likely to stay buried until some archaeologist can command a field budget of more than ordinary size.

That the mound has the form of a bird suggests another way in which it may have had religious meaning—as a sacred effigy. The highest point appears to represent the head of the bird, the ridges to the north and south the wings, and

Impressions in clay showed the weave, shape, and size of the baskets used in carrying the more than half-million tons of earth.



the flat platform to the east the tail. If this is correct, the bird is shown flying due west from the center of the octagonal village.

Even this was not the end of the earth-moving done by these ancient people. A mile due north of the center of the village lies the so-called Motley Mound. It measures 400 by 600 feet at the base and is 56 feet high. In its proportions and details, it is identical with the Poverty Point Mound, but it lacks the tail and is flying north from the village. Motley Mound represents about 2½ million more man-hours of labor. When we see how much these ancient engineers seem to have loved symmetry, we can imagine that they may have designed similar massive bird effigies to the east and south of the octagon. These would have been erased by the later cutting of the old courses of the Arkansas River.

A relatively small conical mound, situated some 700 yards north of the Poverty Point Mound, seems to stand apart from the rather formal arrangement of the other structures. This 20-foot cone has the usual shape of mounds built elsewhere as tombs, and for this reason we excavated it during the 1955 season. It had been built over a large bed of ashes, about six inches thick, which extended over the entire area covered by the mound. Small charred bone fragments were scattered through this ash, mostly too fragmentary for identification. Only one was undoubtedly human. This is rather slender evidence, but it is possible that this cone was built to cover the site of a crematory fire.

With the aim of determining the age of this cone by the Carbon 14 method, the radioactivity of the charcoal was measured. Tests were made by Dr. Lawrence Kulp of the Columbia University Radiation Laboratory and by Fred Schatzman, an ingenious high school junior of Highland Park, New Jersey, who as a hobby has set up and is operating his own laboratory. The Carbon 14 method does not determine an exact date but rather a range of time in which the true date probably falls. The results of these separate tests were in good agreement and are almost certain evidence that the great fire built on the site of this mound was kindled about 700 B.C.

The mound was built in three clearly defined stages. At each stage, the top was made level and some ceremony was probably performed. After the second level had been completed, the Indians did something any back-weary archaeologist can sympathize with. They threw down several hundred baskets and skins filled with earth and left them there, covering the entire surface of the mound. Casts in the clay show very clearly the weave, size, and shape of the baskets. One of the drawings accompanying this article was made from these impressions.

The culture of the inhabitants of Poverty Point appears to be related to early phases of an ancient culture that has been pieced together far to the north. This is the so-called "Burial Mound I" or the "Middle Woodland" cultural stage of the Upper Mississippi Valley. Well-known aspects of this stage are called the Adena and Hopewell Cultures. The exact nature of the connection between these and Poverty Point is not yet clear. One possibility is that the more sophisticated ancient Yankees invaded the South, conquered the local Archaic peoples, converted them to a religion centering about the great Bird Spirit, and set them to work on a well-planned, spectacular, but apparently unnecessary, community project. It would certainly not be the only time in history when something like this befell a people.

The Poverty Point site was the largest and most complex geometrical earthwork in North America. It would certainly seem appropriate that the half of this 2700-year-old public work that has been spared by the restless rivers of the flood plain should be preserved for the education and pleasure of the people of our modern civilization.

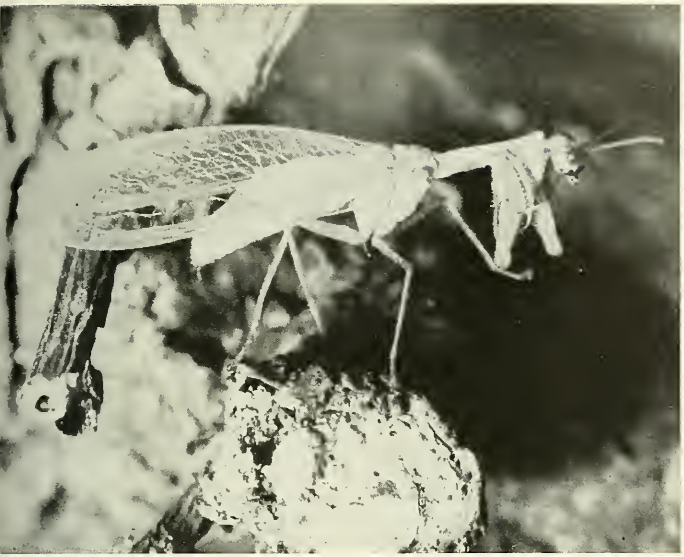
▲ THE MANTISPID is less than an inch in length but its appearance and habits make up for its small size.

An Insect Masquerader

Though not related to the mantis, the mantispid has become its diminutive counterpart through convergent evolution

By RAYMOND J. STEIN

INSECTS are found from the steaming tropics to the frozen polar wastes—flying through the air, crawling and burrowing in the ground, swimming in the water, parasitizing plants and animals, and even growing their own food supply. One can find enough strange insects close to his doorstep to satisfy his curiosity throughout life; but here is one that is not common. Many naturalists have lived their allotted span of years without ever seeing a living mantispid.



▲ In many ways this insect resembles a miniature praying mantis for which it was named, but no close relationship exists.

▲ The mantispid pupa emerged from the spider egg cocoons that were attached on the underside of a small piece of bark.

So, when two emerald green specimens were suddenly noticed in one of the terrariums of the Newark Museum's Nature Corner, a great deal of interest was aroused among the staff members. The insects were less than an inch long, but their appearance and habits more than made up for their small size.

The two front legs of mantispids are large, spiny, and clawlike, serving as springtraps and clamps for grasping and holding the wriggling victims on which they feed. The head is small and triangular, with two large compound eyes and a pair of clublike antennae. The thorax is long and thin, encasing the muscles that move the delicate lace wings. The abdomen in many cases resembles a wasp's. The coloration of the insect varies with the species, but green, brown, or a combination of the two is usual.

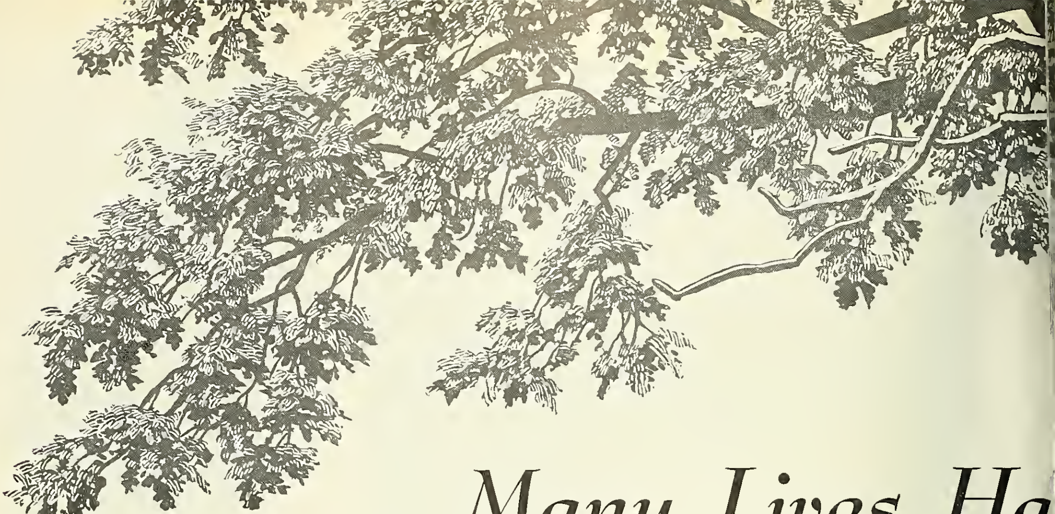
A glance at the photographs will show how strikingly our mantispids resembled miniature praying mantises. The similarity is remarkable evidence of similar development in two of nature's unrelated forms.

The shed skins of our newly transformed adult mantispids lay near by in the terrarium, and closer inspection revealed some egg cocoons of Lycosa spiders (commonly called wolf spiders). Upon checking through some entomology books, we learned that it was quite normal for these emerald insects to emerge from the spider egg cocoons, which they had been parasitizing.

Although many details are still hidden from the searching eye of the entomologist, some of the secrets in the life history of this creature have been uncovered. Adult mantispids are known to lay small, smooth, oval eggs varying from bright red to white, depending on the species. Instead of attaching the eggs directly to a bit of foliage, the mantispid fixes them to a long hairlike stalk, which in turn is made fast to a leaf or twig. This seems an effective protective device, for a marauding insect would have difficulty finding the eggs and would then be forced to climb the slender stalk in order to dine on them.

The eggs hatch into active larvae, which are themselves ferocious hunters. Upon finding a suitable food reserve, possibly the egg sacs of Lycosa spiders or Polybia wasps, they enter into a parasitic existence and become inactive creatures resembling white grubs with almost useless legs. After feasting as parasites, the mature larvae spin cocoons and pupate in the last larval skin, remaining all the while within the spider's egg cocoon. Finally, they break through the silken cocoon, shed their skins, and emerge as adults. They then lead a predatory existence, mating and continuing their race with the laying of eggs.

The mantispid clan is a small one in the vast world of insects. Only 170 species are found throughout the world, with just 6 of these in North America. The mantispids belong to the order of insects called Neuroptera, or "nerve-winged," because of the network of veins running through the rainbow-lustered membranes of their wings. The lady lacewing fly is one of the more common of the mantispid's cousins but is frail compared to this aggressive and more sturdy-looking impersonator of the mantids—which we nominate as one of nature's most interesting oddities.



Many Lives Ha

The Monarch of the Forest gives safety and sustenanc

THIS is the story of a tree—not so much of its life, with which we are familiar, as with its afterlife, of which most of us know less.

More than three centuries ago it was an acorn that had nestled in the debris of the forest floor. It was one of many such acorns that had matured upon the great parent oak beside the brown river.

Nature in her wisdom had caused the oak to produce many acorns, but only one had survived the host of creatures that fed upon their rich but bitter meat. This one acorn lay hidden from its various enemies, and slowly the winter rains and snows softened its hard outer coat, and moisture penetrated to the living embryo within, causing the complex growth processes to begin It was a long road that lay in front of the infant oak—not a road across space, for a tree must remain where its life begins. The oak's trail led across time. Human children that were born at the time that the acorn began to sprout had returned to their Maker while the tree was still in vigorous youth. Time means different things to different creatures. To the May fly, a day is a lifetime; to a giant Sequoia, a day is merely a moment in a 3000-year span.

And so the oak grew into maturity and then slowly into venerable age. It spread its roots far through the sandy soil, and the vital minerals and water were drawn upward through the myriad labyrinthine tubes to the numberless branches in the green mansion above. Each spring, the life processes began their activity anew. Pale green leaves were unfolded upon each twig, and each leaf was a wonderful and complex factory. In them the green chloroplasts, with the aid of the sun, tore asunder the molecules of water from the earth and the carbon dioxide from the air and combined them into carbohydrates — a miracle of alchemy that man in his complex laboratories has never yet been able to accomplish.

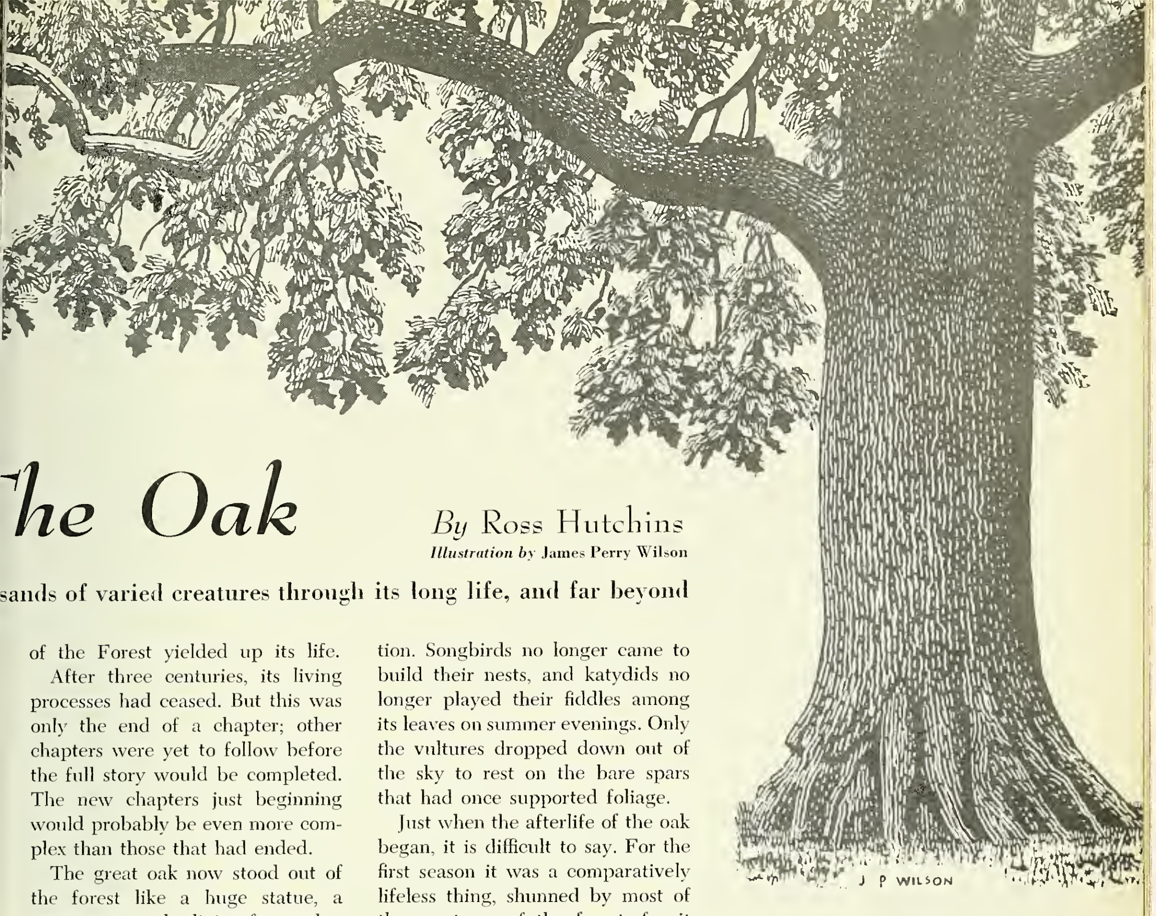
It was an exciting life that the great oak lived, there beside the river. Within the tree itself there seemed to pulse an almost timeless vitality. But among the ramifications of the gnarled and twisted limbs there ebbed and flowed another, separate world of life. There were the romances of the birds which had followed the sun northward thousands of miles from tropical climes, to mate and rear their young in the relative security of the great tree's upper reaches. There were the tragedies, too, when the gray hawk and the silent owl invaded the privacy of the green canopy and captured and devoured the parent birds.

The nights, too, were exciting. When the full moon hung over the lowlands, the wildcat waited for passing prey on the lower, horizontal limbs, and the masked raccoon came to dabble for crawfish and frogs at the margin of the softly flowing river.

And so, in quiet respectability, the oak grew older and greater with the cycle of the years. Each autumn, with one new growth ring completed, the winds carried its leaves away and dropped them into the brown waters of the stream, where they floated like miniature rafts to further adventures; perhaps even to the far-off sea. For there is never really an end to anything, only a change.

One year, there came a change in the ancient oak also. One spring, the great tree did not respond to the tide of the season with its usual cloak of fresh foliage. While the trees about it burst forth with summer dress, some of the elephantine limbs of the oak remained bare.

And so, by degrees, the Monarch



he Oak

By Ross Hutchins

Illustration by James Perry Wilson

sands of varied creatures through its long life, and far beyond

of the Forest yielded up its life.

After three centuries, its living processes had ceased. But this was only the end of a chapter; other chapters were yet to follow before the full story would be completed. The new chapters just beginning would probably be even more complex than those that had ended.

The great oak now stood out of the forest like a huge statue, a monument to the living forces that had created it. It consisted of many tons of cellulose, tannic acid, and resins. Its microscopic structure was complex beyond belief, created by the craftsmanship of countless years of cellular activity. Its 300 yearly growth rings mirrored the vicissitudes of its life — the good years of abundant rain and the lean years of drought. Thus it became a record of three centuries of weather cycles that men might study and ponder upon. Recorded, too, were the years when unusually severe forest fires had burned through its armor of corklike bark.

Now the life-sustaining water that had coursed through its tissues no longer flowed upward by capillary action and osmotic pressure from the vast hidden root system. The hot summer sun had already begun the slow process of desiccation. Songbirds no longer came to build their nests, and katydids no longer played their fiddles among its leaves on summer evenings. Only the vultures dropped down out of the sky to rest on the bare spars that had once supported foliage.

Just when the afterlife of the oak began, it is difficult to say. For the first season it was a comparatively lifeless thing, shunned by most of the creatures of the forest, for it offered neither shade nor haven. As the months passed, however, it slowly began, in a manner of speaking, to live again. Black bark beetles began to bore into the still damp cambium beneath the shaggy bark. Here they excavated tunnels and laid eggs; and when these hatched, the young borers tunneled outward in burrows of expanding size, resulting in intricate and amazing designs. Here also came the strange ambrosia beetles, which bored into the sapwood. Before leaving their former host trees they had become covered with ambrosial fungus spores; and when they tunneled into the oak, these spores grew into fungal mycelia that thrived upon the dead but still moist wood. The beetles fed upon this ambrosial mycelia, for it was their ancestral food and they could not exist without it. Other creatures that began to drill into the oak lived upon the nutriment stored in the wood, but the ambrosia beetles fed upon the fungus that drew its nourishment in turn from the woody tissues.

Among the thousand different insects that might attack the oak were the buprestid beetles that came on wings of burnished copper and bronze. They, too, laid their eggs in the oak, and their flat-headed larvae made serpentine tunnels beneath the bark. Woodpeckers heard the rasping sounds of the insects' jaws as they bit their way through the wood, and they, too, began to sink shafts into the wood with air-hammer blows of their chisel-like beaks, and the staccato sounds echoed across the forest.

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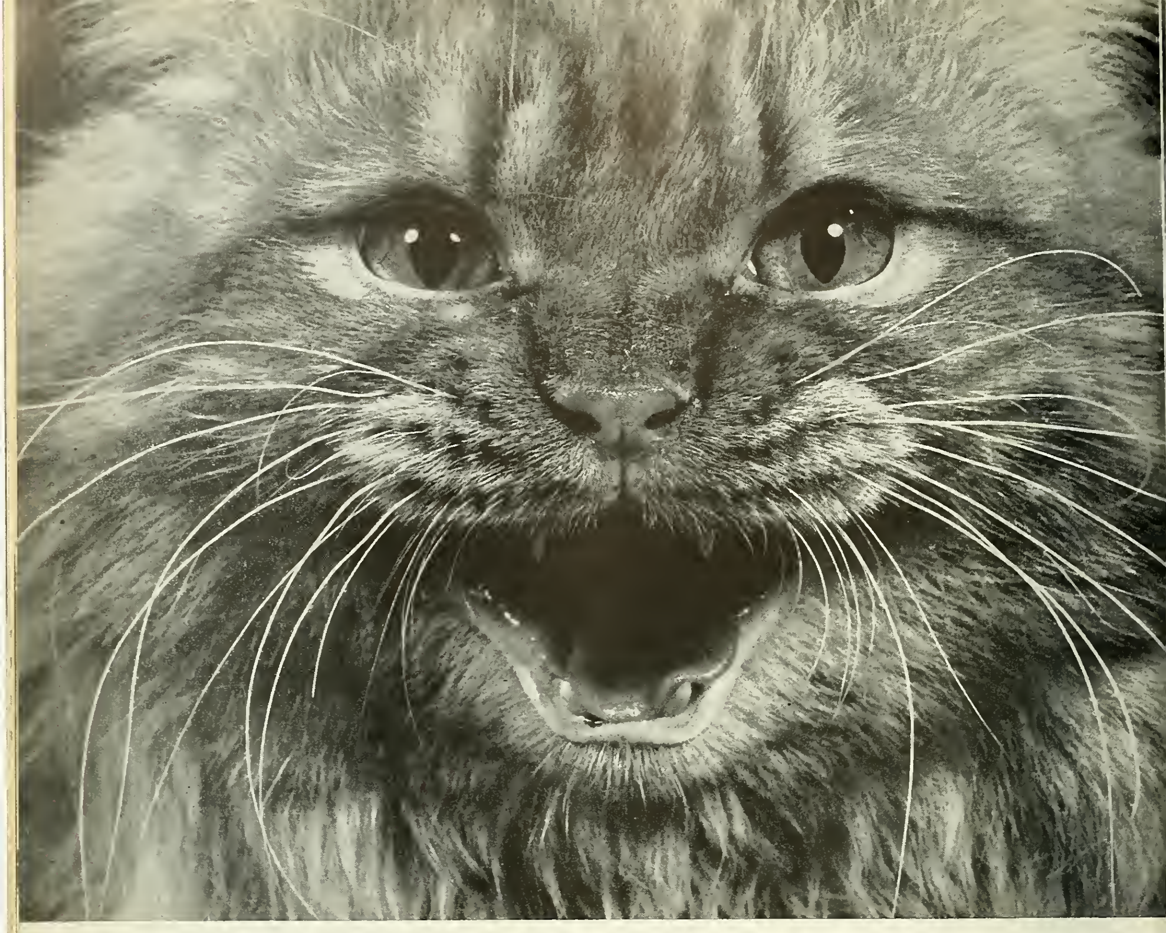

▲ PORTRAIT OF A RED TABBY.

Majesty IN A FUR COAT

By GARY WEBSTER

Photographs by YLLA

Well-fed, well-housed, and well-loved, the domestic cat is America's true aristocrat, and she doesn't want you to tell her how she can earn her keep

NEITHER war-wealthy tycoons of industry nor blue-blooded First Families make up America's real aristocracy. The nation's cats—some in middle-class homes, others in barns and shanties, and not a few in the mansions of the very rich—really constitute the patrician class. Some estimate there are about 40 million of them, but they have never been actually counted.

We swaggering humans like to think they belong to us. Actually, they never have and never will. We are the servants who provide warm homes and rich food. They are the masters, tolerating man but never bowing to him.

Just when and where the domestic cat originated, no one knows. Many thousands of years ago, by a biological freak or "sport," the ancestor of all tabbies may have been born of the mating of Asiatic wildcats. This is only conjecture, at best.[*]

An Arabian legend gives the only really plausible explanation of the origin of the cat. The patriarch Noah, so the story goes, became annoyed when rats and mice began to

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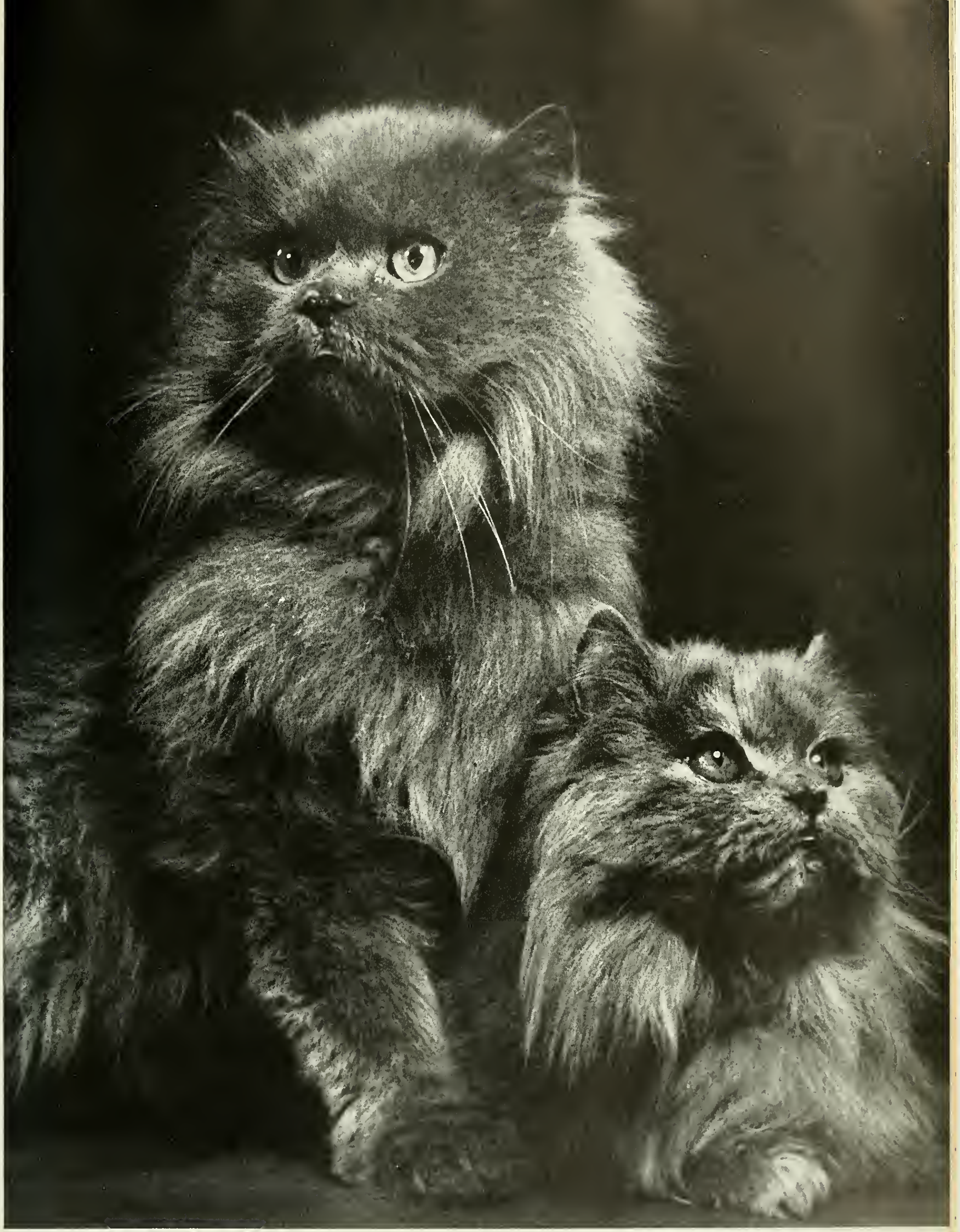
[*] See "Where the Cats Came From," by Edwin H. Colbert, in NATURAL HISTORY for December 1940.—ED.



▲ Two so-called Blue Persians.

multiply on the Ark. He tried to trap the beasts but failed. Whereupon, at his command, the lioness sneezed violently and produced the first cat!

Cats began to be guests in the homes of their two-legged fellow creatures almost 5,000 years ago. Probably it was much earlier, but cat figures appear in Egyptian graves dating from 2600 B.C.

Selective Breeding Difficult

Man began early in civilized times trying to improve on nature by selective breeding of the domestic cat. But he never succeeded as he did with other animals. Special types of horses have been bred for such varied tasks as draft work, racing, and military service. Literally hundreds of widely different kinds of cattle and poultry have been produced. The breeding of dogs has become a science in itself, resulting in such special canine models as the wolfhound, the sheep dog, Pekingese, greyhound, bulldog, and Skye terrier. But puss, basking contentedly before the fire in a New England home today, is essentially the same animal that indolently accepted the homage of Egyptian priests aeons ago.

Even the few special breeds that man has produced quickly lose their distinctive features if crossbred. Such traits as blue eyes and long hair are biologically regressive and disappear unless held by selective breeding. Mate any expensive breed with an ordinary domestic cat, follow the process for two generations; and not the slightest trace of the distinguishing peculiarity will remain.

Few other domestic animals revert to the wild state so quickly and successfully as puss. Several times in history, abandoned cats have gone wild, multiplied, and become a serious source of annoyance.

In 1815, when Napoleon was about to depart for St. Helena, a

▼ "WE are Siam-ese, if you please." And well may they defend themselves as aristocrats among the aristocracy. They are generally conceded to have descended from special ancestry.

resident of Chester, England, perpetrated a hoax, according to E. C. Brewer in *The Historic Notebook*. The jokester had a large supply of handbills printed and distributed, explaining that St. Helena was so overrun with rats that on a certain day an agent of the French government would buy cats. He would pay sixteen shillings for toms, ten for females, and two for kittens. On the day set, the city was filled with men, women, and children loaded with mousers.

When the hoax was discovered, a riot ensued. Four or five hundred cats were killed, but at least a thousand escaped and went wild. They became such a menace to small game and domestic poultry that a regiment of soldiers was dispatched into the forests of the region to hunt and kill them.

A Cat Island

An obscure little island near Tahiti is said to be so overrun with cats that every attempt at colonization has failed. Rats had invaded the island after a ship was wrecked on its rocks in 1862. Soon the pests became a serious nuisance. So a French trader imported a load of 500 cats and sold them at fancy prices. Soon the felines wiped out the rats, then began eating fish and game. They multiplied rapidly and became very fierce. By 1881 the colonists had given the island over to the cats and departed.

Though cases are cited of cats dying of grief on the loss of a beloved owner, they do not usually become genuinely attached to their masters. If the family moves, puss is likely to slip away and return to her old haunts unless gradually accustomed to the new premises.

One of the most famous cases of devotion on the part of a feline occurred in the sixteenth century. Sir Henry Wyat, prominent British statesman, was arrested, thrown into a dungeon, and given no food. He would have starved had his cat not accompanied him to prison, caught pigeons, and brought them to him.

Dog-lovers sometimes complain of the cat's cool independence, but American farmers say one cat is worth $50 a year for the protection it gives food bins. Mohammed is said to have cut off the sleeve of his robe rather than disturb his favorite cat, Muessa, who was sleeping on it. Petrarch had his cat embalmed and placed in a niche in his apartment. And lonely spinsters are not the only persons to leave a fortune to their pets. The largest legacy ever set aside for a cat was $100,000 left to Buster, a mongrel Tom, by attorney Woodbury Rand, of Boston.

Blue-blooded Americans point with great pride to an ancestor who fought in the Revolution. Many families proudly trace descent from passengers who came over on the "Mayflower" three brief centuries

▲ **In many lands, the black cat, stealthy and invisible in the shadows except for its eyes, is feared as a symbol of ill-omen.**

ago. But His Majesty the Cat is descended in an unbroken line from gods and goddesses who received the adulation of human subjects 40 centuries ago—before Moses led the Children of Israel from the land of the Nile.

Worshipped as deities by the ancient Egyptians, cats lived in magnificent temples and were fed like kings. To kill a feline was a crime far more heinous than the murder of a human.

King Cambyses II, of Persia, who had no such regard for Tom, once took advantage of the place he held in the eyes of the Egyptians. When he attacked the city of Memphis, about 525 B.C., he found it strongly fortified. So he hunted up several hundred cats and used them as projectiles, hurling them into the city. Horrified at such treatment of the sacred animal, the Egyptians immediately surrendered.

Cat Mummies

At death, the cats of Egypt were embalmed and reverently stored in sacred vaults. So many were treated in this manner that in modern times the burial grounds have been extensively used as fertilizer quarries. An enterprising English firm imported 180,000 of the mummified bodies in 1895. Sold at auction in ton lots, the auctioneer used an embalmed cat as a hammer!

Such a proceeding would not have been tolerated in some periods. Even in England, the cat occupied a place of great honor for hundreds of years. When the famous Dutch scholar, Erasmus visited the island kingdom in 1499, he found English earls wearing cloaks trimmed with catskin as a mark of high rank. In a letter to a friend, he mentioned the fact that the visitor to an English home was expected to kiss not only his host, hostess, and all their children but also the family cat.

Such tokens of honor were based largely on fear. Stealthy, cruel, and cunning, the cat has represented the powers of darkness and evil since the very beginnings of European civilization.

In ancient Egypt, every member of the household shaved off his eyebrows when the family cat died. This was done to prevent the soul of the animal from taking possession of the bodies of its erstwhile owners. Even today, in northern Europe, peasants believe that black cats turn into devils when they reach the age of seven. A feline that serves nine masters in succession earns the right, they affirm, to carry off the soul of the ninth to hell.

Superstitious fear of cats reached its height in the Middle Ages. Even in 1662, a Scottish witch named Isobel Goudie made a sworn statement that when she and her sister wished to bewitch anyone, they changed themselves into the form of cats. Though the confession was probably secured by means of torture, it led to widespread action against cats.

Many religious festivals were concluded by throwing a sack, box, or barrel of black toms into a bonfire. Spectators collected the ashes and took them home as a means of gaining good fortune. Rural Scots roasted live cats on spits, to drive out the evil spirits in them. The English varied the method by using brick ovens.

No other feature of the cat has played so important a part in its role as have the eyes. Nature offers no easily observed counterpart for the baleful glare of an angry feline.

▲ An Abyssinian, a breed thought by some to come from the jungle cat of India or Africa. The ears are sometimes tipped with long hairs.

The pupils, slit rather than circular, are capable of great dilation. Behind the retina is a special membrane, the *tapetum lucidum*, which causes the familiar weird glow of various colors when light is thrown on the eyes at night.

Ancients noticed the peculiar fascination of the eyes of the cat. Hence the semiprecious stone known as cat's-eye became the symbol of ill luck.

Dark pupils of a Siamese cat flash to ruby in near darkness and when the animal is excited. Just what process is involved, no one knows.

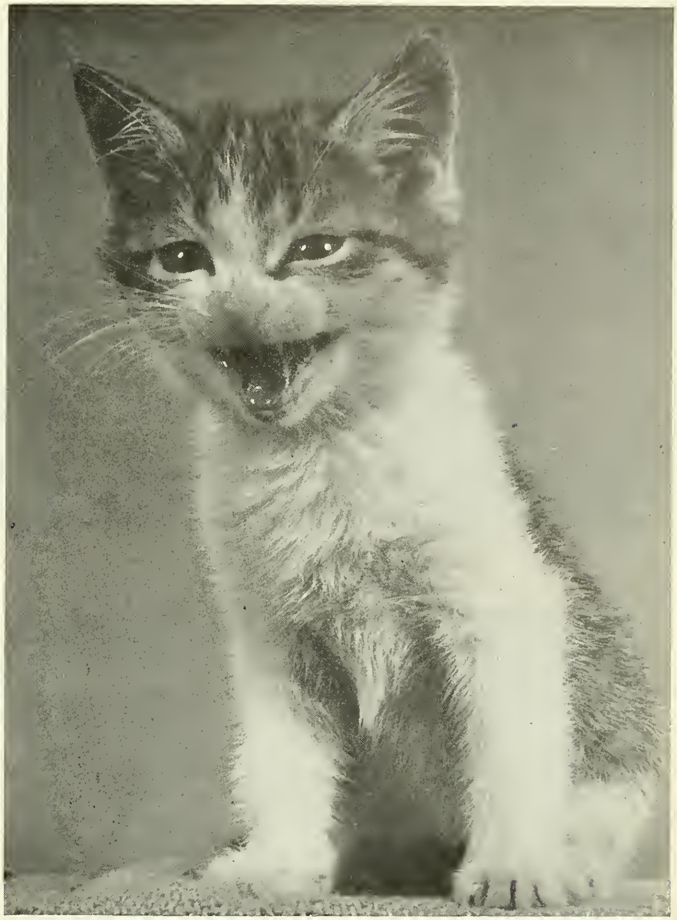
Independent

His Highness the Cat does not step off his pedestal and work for a living. Many domestic animals furnish food to their masters, and others perform useful services. For centuries, household dogs were made to run in treadmills and furnish power for domestic devices. The cat never has and never will submit to such an indignity.

True, the cat wages war on mice and rats. But those who know Tom best believe that his motive is not always food but the pleasure of destroying hereditary prey. For centuries, there have been traps and poisons far less expensive and more efficient as destroyers of rodents than are cats. Modern poisons are actually putting Tom out of the extermination business.

But his hold on civilization will not be shaken. In countless decades of domestication, he has never for an instant relaxed his grip on his human subjects—in spite of the fact that the cat has given far less to civilization than any other domestic animal.

As a matter of fact, only two cases are known in which the cat made a real contribution to progress. It was a lanky Tom, hungry after a night of prowling, who tried to catch a chicken in a pen and pulled feathers through the cracks to give Eli Whitney the idea for the cotton gin. And it was an anonymous mouser that unwillingly started Benjamin West, the great artist, on his career. He made his first brush with hairs snatched from the tail of the family cat.

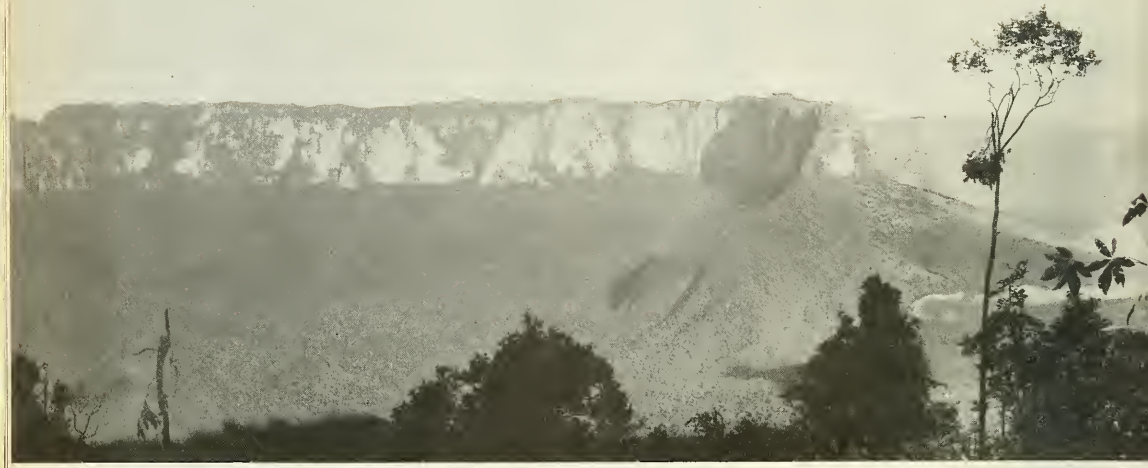


▲ **Photographing** the facial expressions of cats has long been a favorite pastime, but it takes patience and close-range equipment.

Every attempt to put puss to work has failed. Just 75 years ago, cat lovers of Liége, Belgium, formed a society for "the improvement, mental and moral, of the domestic cat." Because felines have an unfailing sense of direction, the organization wanted to use them to carry messages in place of carrier pigeons. Preliminary experiments were made up to a distance of 20 miles, when the plan was dropped. Just what steps they took on the moral issue, history does not record.

Don't be deceived into thinking that cats ever intend to concern themselves about earning their board and keep. Work is for humans. Daintily, ever so daintily, Tom will pour his supple body on the floor after consuming a bowl of milk and a platter of liver.

Just as his long-dead ancestors blandly accepted the homage of respectful Egyptian vassals, so he permits a few caresses—not too ardent or familiar — from his two-legged subjects of the twentieth century. Then, purring solemnly, Majesty in a Fur Coat drifts off into regal slumber.



▲ THE OUTLOOK from Bluff Camp. In the distance in the right is the summit that was finally reached.

Attack on Chimantá

By JULIAN A. STEYERMARK
Chicago Natural History Museum

IN the borderland between Venezuela and Brazil rise a number of table-top mountains, the almost inaccessible summits of which are the home of primitive as well as specialized types of plant life. One of them, Mt. Roraima, was the original Lost World selected by Sir Arthur Conan Doyle as the setting for his famous novel of exploration.

Ten years ago, while in quest of sources of quinine for the United States Government, I had the opportunity to explore Mt. Duida and Mt. Roraima. Later, under the Chicago Natural History Museum, I visited Ptari-tepui.* But the largest of the table mountains was the Chimantá massif, consisting of Chimantá-tepui and, to the east, Acopán-tepui; and I hoped some day to return to explore it. Imagine my excitement and delight when the Chicago Natural History Museum authorized me to make an expedition to do this.

I was to approach the mountain from the west, and Dr. John Wurdack of the New York Botanical Garden was to approach it from the east.

Back in 1946 the ornithologists, Billy Phelps, Jr., and his wife Kathy, led by the great Venezuelan explorer Captain Felix Cardona Puig, opened the trail on the western part of Chimantá-tepui, and I expected no trouble in reaching the summit by this route. What a surprise was in store for me!

After trucking a ton and a half of camping equipment and collecting material from Caracas to Ciudad Bolivar, we purchased the necessary cassava, brown sugar, coffee, rice, black beans, canned corned beef, and the like and flew to Urimán, on the Caroní River. This was to be our last contact with civilization, and here I found my Indian workers for the trip. I left on March 24, 1953, with six men and the wife of one, who was to serve as cook. Unknown to me from the beginning, these Indians had an understanding with the Civil Chief of Urimán to work for no longer than a month.

From the beginning, rain slowed our progress. At first, the Phelps-Cardona trail and camp sites were easily located. But the trail leading to the fifth camp was more difficult to follow, and the guides lost their way. We lost several days, and when finally we found the fifth camp site, we were all dead-tired and wet. There was only an hour left before dusk. Our clothes were blackened and stained by the constant rubbing against wet slopes and mossy branches, and eight miles with heavy packs had left the men in poor shape to construct a

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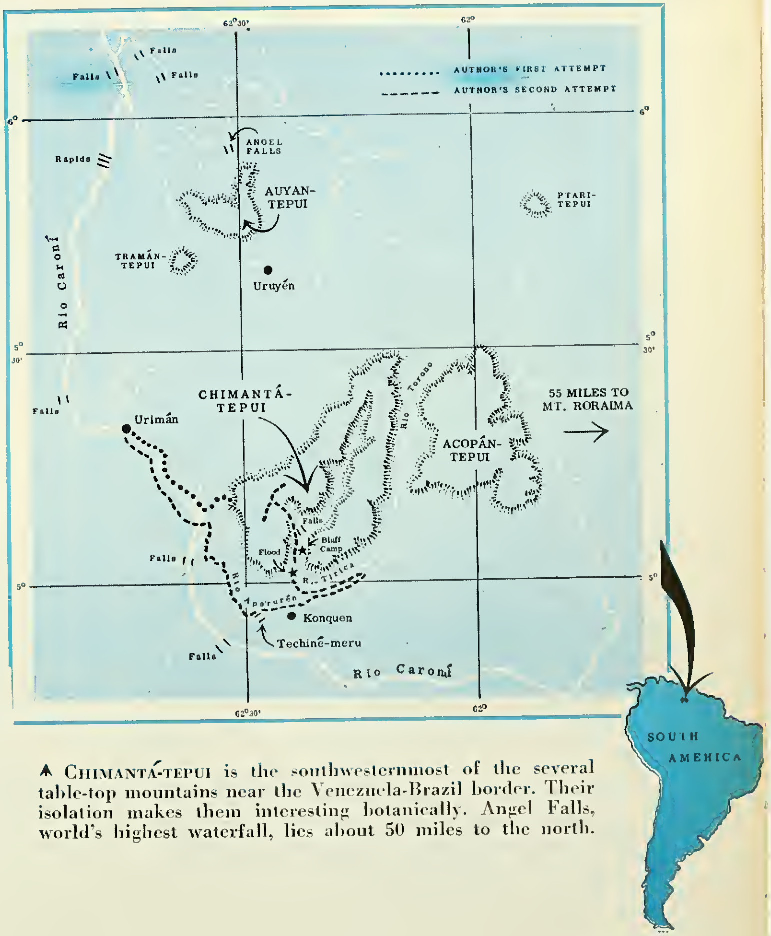
*The word *"tepui,"* connected with several names in this area, means "mountain" in the Arekuna or Taurepan dialect.

The largest of the “Lost Worlds” of South America thwarts a ne explorer on his first attempt but yields to his second

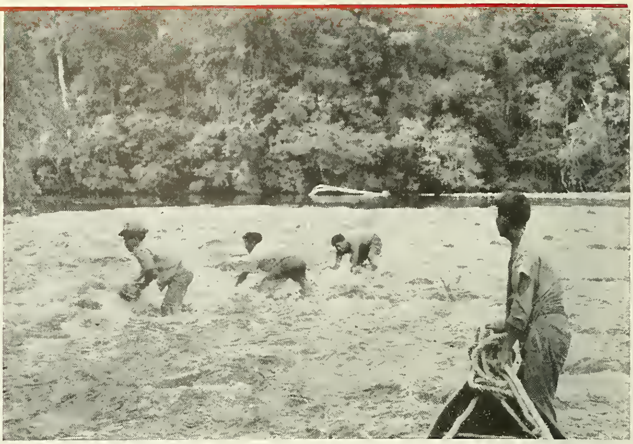
crude thatched shelter and kindle a fire in the rain.

Wind blew the cool rain into our small shelter. Sleep was impossible. The firewood was soaked, and we were able to produce only a little smoke and practically no heat to warm us as we huddled below the middle of the roof to keep dry.

Dawn found us fagged and in poor spirits. Presently, José came over to tell me that the Indians were planning to leave and go back to their more comfortable homes. I was stunned. After having spent over half a month coming to this distant spot, actually within striking distance of our goal, they wanted to quit. I promised them higher wages and said that they would reach their homes at the end of a month's time. They seemed to be satisfied with this arrangement, and the threat of failure was averted at least temporarily.


62°30'
62°
Falls
Falls
Falls
AUTHOR'S FIRST ATTEMPT
AUTHOR'S SECOND ATTEMPT
6°
6°
Rapids
ANGEL FALLS
AUYAN-TEPUI
PTARI-TEPUI
TRAMÁN-TEPUI
Uruyén
Rio Caroní
5° 30'
5° 30'
CHIMANTÁ-TEPUI
Falls
Urimán
Rio Torono
ACOPÁN-TEPUI
55 MILES TO MT. RORAIMA
Falls
Bluff Camp
Flood
Falls
R. Tirica
Rio Aparurén
5°
5°
Konquen
Techiné-meru
Falls
Rio Caroní
62°30'
62°
SOUTH AMERICA

▲ CHIMANTÁ-TEPUI is the southwesternmost of the several table-top mountains near the Venezuela-Brazil border. Their isolation makes them interesting botanically. Angel Falls, world's highest waterfall, lies about 50 miles to the north.



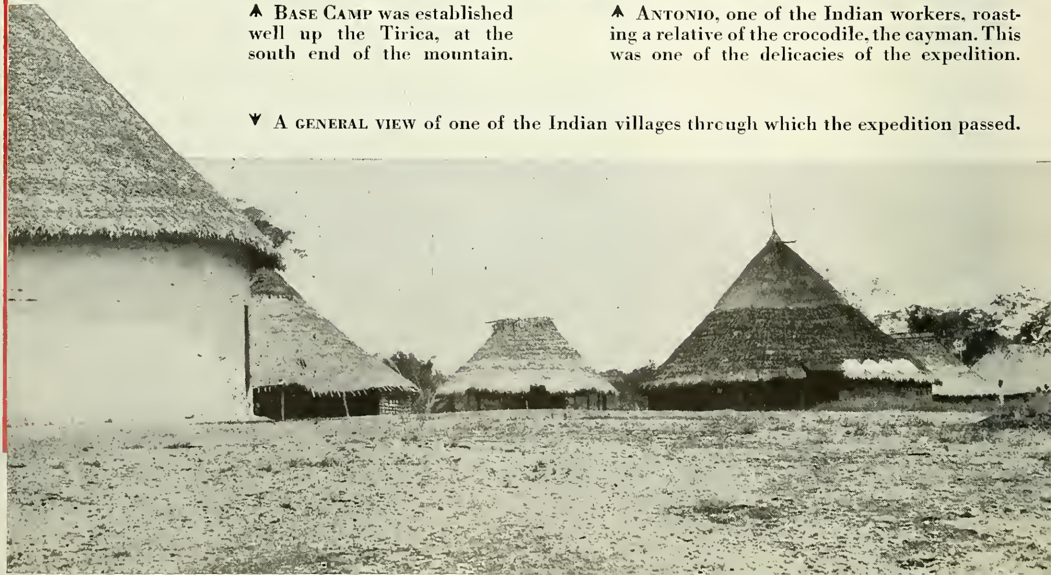
< **View** from the Base Camp at 1,600 feet.

▲ **As the expedition** poled its way up the Tirica, the men sometimes had to heave large boulders out of the way to permit progress. Fast water added to the danger.

▲ **Base Camp** was established well up the Tirica, at the south end of the mountain.

▲ **Antonio**, one of the Indian workers, roasting a relative of the crocodile, the cayman. This was one of the delicacies of the expedition.

▼ **A general view** of one of the Indian villages through which the expedition passed.



But the going grew steadily worse. In order to walk, one had to lift oneself above the ground to an overhanging branch, step gingerly along the aerial limbs, and then drop back to the wet ground. This procedure was repeated endlessly for hours. It was very tiring to fall into depressions on the ground or between roots. The struggle had continued for several hours when Juan, another one of the Indians accompanying us, suddenly stopped and said, "We're going back. It's too dangerous and difficult to go any farther."

I tried to reason with the men but could not persuade them to go on. My dreams were shattered. I had collected many valuable specimens but had failed in my main objective.

Downhearted and discouraged we made our way back to Urimán.

I was still determined to get to the summit of Chimantá-tepui and decided to approach the vast mountain from the south. I made it quite clear to the newly selected group of Indian workers that we would be gone as long as necessary to reach the highest part of the summit—our goal. All agreed to the plan. This time I had every reason to expect success, as my chief Indian leader was none other than Sabas Cardona, the young Camarata Indian who had worked so well for me ten years before at Ptari-tepui.

As I was to be away from this last port of civilization for an indefinite period, it was necessary to reserve return passage to the United States far in advance. Accordingly, I set July 29 as my date of departure from La Guaira. I told Sabas that we had to be back in Urimán by July 15. With at least three months ahead of us, we seemed certain of achieving our goal.

We filled three dugout canoes with waterproofed canvas bags containing our cassava and the necessary materials for pressing plant specimens. I took along 100 pounds of salt as a good-will gift for the Indians who lived along the river.

On this trip there would be many more days of river travel than before. It was also a more dangerous trip from the standpoint of treacherous rapids, and a more strenuous one in portages.

Three days on the Caroní River brought us to the Aparurén River. Tall, dense forest closed in on both sides of the stream. Another day upstream brought us to a magnificent waterfall known as Techinémerú, 250 feet high and a quarter of a mile wide. Since we could not continue without a long portage, we camped here for the night.

An Upset

The next morning, the canoes were loaded in quiet water at a safe distance above the brink of the falls, and we started upstream. The boat containing all the food cooking equipment, roasted capybara, and my bedding took the lead. We had gone only a few yards when the boatmen, entering some rapids, misjudged the direction of the current, and we were unable to prevent the boat from capsizing. Fast work was needed to surface-dive for the sunken loads, and the Indians kept bobbing out of the water and retrieving one piece after another. What good fortune to be able to rescue the 100-pound sacks of rice and beans from the depths of the water! Even the parts of the roasted capybara were found.

Now the wet clothes, rice, and soaked foods had to be spread out on the near-by rocks to dry. By about noon the canoes were again loaded, and we cautiously proceeded past more rapids. Late that afternoon, we reached the Indian village of Konquen.

Before entering the village, Sabas and the other Indians changed into their cleanest clothes. To them, it was an important event. For my part, I hoped to get more men to help carry our cargo in the mountains.

About a dozen circular houses with conical palm-thatched roofs occupied the clearing. The usual bowls of fermented mulberry-colored cassava drink (*kachiri*) were passed around. Despite the unsanitary condition of the communal drinking vessel, courtesy demanded that I share this gesture of hospitality. Half shells of calabashes filled with hot pepper sauce (*kumachi*) were placed before us on the ground, and we each dipped into them to moisten our piece of cassava. Such is the customary etiquette in this part of the world.

Across the village and beyond the sea of forest stretched the rugged profile of Chimantá-tepui, 50 miles in one direction and 40 in the other. What it held in store for us could only be conjectured.

Gifts from the Indians were put in our canoes the next day—freshly baked cassava; pineapples, bananas, and other things. Augmented by the additional carriers, we proceeded upstream and soon entered the fast water of the Tirica River.

As the current became swifter, and the gradient steeper, rocky stretches blocked our progress. Fast water and shoals constantly placed our canoes in peril. The Indians daringly struggled to pole and pull them past protruding boulders, whirpools, and submerged logs, but sometimes we had to get out and remove large obstructions in our course upstream.

It took ten days to reach the spot where our first permanent base of operations could be located. It was now pleasant to watch the splendid co-ordination of the Indians, with Sabas acting as director. They operated as a closely working team in erecting our palm-thatched shelter and an adjoining hut to serve as kitchen.

Fresh meat—wild peccary, tapir, paca, guan, curassow, and tinamou—was plentiful here in the virgin forest, as well as assorted fishes and an occasional relative of the cayman. This diversity relieved the monotony of our ever-present corned beef. Tiny biting flies the size of midges made life miserable in the early morning and at dusk.

▲ SPECTACULAR TACHINÉ-MERU, a falls about 250 feet high and a quarter of a mile wide.

▲ THE EXPEDITION'S success was due to the efforts of the Indian guide, Sabas Cardona, and his wife Emiliane.

▲ THE MEN SLEPT in hammocks well protected from insects that carried disease. Vampire bats were also common.

Also, in these dense wet forests below 3000 feet, there were minute sand flies belonging to the genus *Phlebotomus*. They are dangerous biting insects, for they carry the protozoan parasite that produces leishmaniasis. This dreaded disease of this section of Venezuela and other parts of the tropics often leaves deep scars on the neck, ear, nose, or forehead.

Our immediate concern was to find a path to the summit of Chimantá-tepui. Sabas set out with two Indian workers to begin the trail to the summit, and a couple of days later he returned and reported that he felt sure he had found a route. Another few days passed while he and his party continued breaking the trail.

Three weeks had now elapsed since leaving Urimán, and time was rapidly fleeing. We had already been at the base camp ten days, and I was anxious to get ahead to higher ground. When Sabas and his party returned a few days later, they bore good news. The trail was now ready as far as a camp site that would lead us to the summit. That night we celebrated with a banquet including a wild peccary and a couple of curassows.

Everyone had retired to his hammock for the night when I was suddenly jarred from deep slumber by shouting and shrieking from the Indians. Sabas hurried to tell me that an awful catastrophe had befallen us. One of the men on our side of the river, having accidentally awakened, had heard rapidly rising water swishing against the trees. The banks were being flooded, and water was backing up among the trees. It had risen so fast that the Indians on the other side, asleep at the time, were trapped unaware. Our men were now yelling at the top of their voices, telling the others to abandon camp at once. Sabas and four other Indians on our side jumped into two dugouts and struggled across the swirling flood to the other side. The victims were in danger of being drowned. But three rescue trips brought them all safely to our side of the stream and avoided a tragedy.

With the break of day, we all started up the trail. In a few hours we crossed a small stream, then continued the ascent up the densely forested slopes. Finally we arrived at a spot to camp for the night, and the tarpaulins were stretched tightly across a ridgepole for shelter.

The next morning, the trail ascended more steeply. Soon we were climbing a slope of about 60 degrees, and it was necessary in many places to grab tree roots and branches to lift ourselves above slippery and difficult parts of the trail. I began to notice that the trail was steadily approaching the base of some high cliffs. My altimeter read 5000 feet. We were about to reach our destination.

But no. What I found was not a trail leading to the summit, as Sabas had said, but one ending abruptly against the base of cliffs that rose 1000 feet vertically above us. All my hopes were shattered.

I made it plain to Sabas how disappointed I was with his complete misunderstanding of my plans. Even if we could find another route, this mistake had seriously shortened our work on the summit. His only excuse for having erred was, "Well, I followed a ridge leading to the right and reached the summit of it. I thought this was the summit you wanted to explore."

I was amazed at his explanation, as I had clearly pointed out at the beginning that I wanted to climb above the highest rim of bluffs to the highest part of the summit, which I had failed to do on the first trip in April. He admitted his error, and I was helpless to argue with him. Now the only way I could be certain of ever reaching my goal was to forget about any collecting for a while and go along with the trail-makers to direct their operations.

It was first necessary to descend the steep slope we had just climbed, proceed upstream, and establish another camp site. A few days later on June 11 we were ready to begin our final assault, but somewhat less than a month now remained in which to complete the trip to the top and back, including the journey downstream through the dangerous rapids to Urimán.

As we climbed, we could hear a rumbling and roaring in the distance. The sound grew louder until we emerged on the rocky banks of a stream, which proved to be the upper part of the Tirica. Presently, we were surprised to behold a beautiful waterfall above us, a long streak of white hemmed in by a narrow canyon, between the dark green of the forest. Later we approached more closely to the waterfall and estimated its height at nearly 500 feet. The Indians named it Steyermark Falls in my honor. I was quite thrilled.

There followed three more days of trail-making. The trees and shrubs had now become dwarfed. We had been making our way through *Bonnetia* forest typical of the upper zones of these mountains. The leaves on the many kinds of small trees and shrubs were now of a thick, rigid, or leathery type, often small and shiny—well adapted to the extremes of wind, rain, and intense sunlight.

It was in this elfin forest that I collected a rare and beautiful frog, a female of the species *Otophryne robusta* Boulenger, of which only two previous specimens, both males, had ever been collected.

The Top

Finally we were on the last ascent, with only one bit of bluff still barring us from our goal. To surmount this, we had to cut a ten-foot branch and place it against the sheer rock wall. We shinnied up this and forced our bodies through a narrow fissure in the rock. The rest of the way was easy. In ten minutes, we had passed the last ledge and were on the summit, at 8200 feet. We had finally made it, on June 19, eight weeks after leaving our airport base at Urimán.

But what an infinitesimal part of the summit this was. In the few days at our disposal, we could only cover perhaps one per cent of the entire area. Yet in the next few days, this botanical fairyland proved a fascinating hunting ground, and things moved as fast as a three-ring circus. Everywhere around us there were new plants of all shapes, colors, and categories. No one had previously seen the like of them. Giant rocks jutted up at 45-degree angles for nearly 100 feet. Mushroom-shaped boulders and strange formations carved by wind and weather greeted our eyes. Plants with naked, woody, stiltlike stems, each topped by a dense rosette of silvery leaves and purple flowers, were recognized as a peculiar species of *Pagamea*, related to one I had collected on Ptaritepui nine years earlier. Various members of the composite family, comprising unknown and unnamed genera, grew everywhere. They were fantastic. One of them had brown woody stems a yard or two high, crowned from bottom to top with thick woolly leaves and shiny red flowers. Each plant was different from anything seen below on the lower shoulder of Chimantátepui.

If someone had told me that I had been dropped on a patch of Martian landscape, I could hardly have expected anything more bizarre. Small birds approached closely without fear and peered at us as though curious to examine their first human animals. Large conical snails with black irregular mottling on a brown background were perched on low shrubs. Four different kinds were collected, and subsequent study by Dr. Fritz Haas, conchologist of the Chicago Natural History Museum, proved that all of them were undescribed species. But, in general, animal life

The summit abounded in strange new plants. One was an unknown member of the Daisy family, similar to forms found on Africa's Mountains of the Moon. Rocks rose 100 feet into the air. Birds approached unafraid.

was rare. There were no large birds or mammals to surprise us.

It was exciting exploring and collecting on the summit, but we had to end it, and with great reluctance I bade farewell to this paradise. I left a note in a bottle recording our ascent, and we descended.

All went well until we came within sight of the stream. Twelve days before, rocky boulders had provided an easy crossing on foot. Now it was a violent, flood-swollen river, invading the trees along the banks. Rapids churned everywhere with great force. We could not possibly cross it. We were trapped.

At this spot two small islands stood in the river, and we hopefully looked for any large trees that we could chop down to use as a footbridge. The men selected a likely one and hacked at its base for 20 minutes with a lightweight ax, which was all we had at this altitude. The tree crashed with a thud but fell wide of its mark. Another tree was cut, but the swift current swung it around as it fell and washed it downstream. The same fate befell each of several others. By late afternoon, we saw we could do nothing further and made camp.

We continued our efforts the second day and succeeded in felling trees that got us to the second island, but we had not achieved our third and last crossing. Our food supply had dwindled to at most two more meals. If we didn't get out by the following morning, our prospects would be desperate. Our plant specimens must soon be dried by artificial heat or they might completely spoil. Our only hope depended upon dry weather.

Just before daybreak of the third day, we all awakened and prepared our packs to leave. The river had dropped considerably during the night, and we were all set for action. We selected a large tree that would carry us to the opposite side if it fell properly, and the men started hacking away. The ax handle chose that moment to split in two! Two of the men went to work with their machetes, and after a long fifteen minutes of tense waiting, the giant tree gave way, crashed, and provided a solid landing on the opposite side. We shouted and cheered.

We hurried across the bridge and at 3:00 in the afternoon we reached our Bluff Camp. Eagerly we served ourselves huge helpings of cassava and ate cassava crumbs mixed with brown sugar and water. Then we cooked black beans, spaghetti, and coffee. The dried prunes and raisins I had saved, together with a little peanut butter, seemed like ambrosia.

Several Missing

Sabas' wife Emiliana and her brothers had not appeared by nightfall, and I began to worry about their welfare. Quite possibly they had had an accident crossing the river. Or, being without food practically all day, they could have become too weak to continue. It was not possible for them to pass the night comfortably along the way. I worried through the hours of darkness, and morning brought no relief from my anxiety, for all the Indians either went on toward the base camp or had set out with Sabas previously in search of an alternative trail. This left me alone.

Being the only white person on this expedition, I had felt a certain loneliness ever since the beginning of the second part of the trip three months ago. I had only Sabas to converse with in Spanish, as the other Indians spoke among themselves in the Taurepan dialect. Loneliness now descended upon me with its full weight. The bluffs rising above our camp and the forests below were shrouded in gloomy fog.

The morning passed and still there was no sign of Sabas' wife. Every now and then I shouted to see if I could get an answer, but there was no response. The day wore on. Finally, in the middle of the afternoon, some of the Indians drifted in, and about 4:30, to my great relief, poor Emiliana and her brothers came trudging wearily up the trail. While they bolted down hot beans, rice, cassava, and coffee, Jacinto explained that they had been delayed through weakness resulting from fever and colds.

The next few days were spent in preparing the plants for drying. First, each one was recorded by number in the notebook, then pressed between dry newspapers, corrugated aluminum sheets, and felt driers. When a stack became tall enough, it would be wrapped together in the press and placed edgewise in a supporting frame above a gasoline stove, with a fireproof cloth draped around the sides to keep in the heat. We devoted about a week to this but dared not tarry longer. Owing to the rains, extra time might be needed in the rapids.

I held my breath as we sped down the swollen river at what seemed like 40 miles an hour. The slightest mistake on the part of our Indian boatmen could easily capsize a canoe. They had to be alert for any boulder or log that might upset us. Fortunately, they handled each perilous situation expertly, and in due time we were again in calmer water, paddling down the Río Aparurén, and then into the Caroní. Two more days brought us to the airport of Urimán.

It had been a rough trip, but we had finally accomplished our objective—reaching the high summit of Chimantá-tepui.

Between December, 1954, and April, 1955, Dr. Wurdack and I returned on a joint expedition to Chimantá-tepui and were able to spend most of the time on the summit. But somehow the tribulations and unmitigated responsibilities of that first journey to the top of Chimantá-tepui will remain in my mind as the indelible impression of what a mountain can mean to a person.

The results of the joint expedition made by John Wurdack and Julian A. Steyermark in 1954-55, as well as the journeys preciously made by them to this part of the Venezuelan highlands, will be published by the N. Y. Botanical Garden at a later date.

★ **FOR THE** ★
FIRST TIME

A complete photographic analysis of one of the most extraordinary methods of locomotion in the world of nature

Unwinding the Sidewinder

By

WALKER VAN RIPER
Denver Museum of Natural History

Photographs by the author

▲ THE SIDEWINDER has two horns over its eyes, which may give some protection against windblown sand. In its sandy world, the normal method by which snakes move would be almost useless.

THE Sidewinder, or Horned Rattlesnake (*Crotalus cerastes*), is a denizen of the dunes and is found in desert areas of southwestern United States and northwestern Mexico. As its name implies, this snake is of particular interest because of a unique method of locomotion that enables it to move over the shifting, wind-blown slopes of sand dunes as rapidly and efficiently as other snakes move on solid ground. Few people understand exactly what the sidewinder does. I didn't, and I resolved to find out.

Sidewinding has been variously described as a "side-flowing, looping motion" and "a crawling sidewise, looping the body in the form of an S." It has been said to employ "the device of a caterpillar track" and to be "essentially a rolling movement."

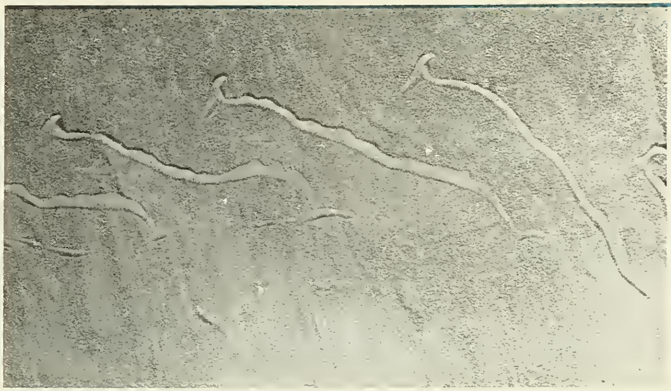
Curiously enough, all of these statements are, to some extent, true. Yet all of them together do not convey a clear idea of what the sidewinder does. Sidewinding is not a complicated movement; it is only unfamiliar. And any attempt to describe it in words alone is apt to fail, just as does a verbal description of the song of the robin.

Nor do the curious tracks the sidewinder leaves help as much as you might expect. I well remember when I first saw a picture of these slanting, parallel marks. They are nearly straight, and each one extends the full length of the snake, with no marks whatever between them. It would seem that they could only be made by the snake's jumping or flipping from one position to the next and landing fully extended. I experimented with the spring from a screen door and thought I saw just how the thing might be done.

Actually, nothing could have been wider of the mark than my first explanation, as I saw later when I obtained several of the snakes and watched them move in a bed of fine sand. It was then that I undertook to analyze the movement by means of the high-speed electronic flash invented by Dr. H. E. Edgerton of M.I.T., which is a superior instrument for investigations of this sort. Gradually the full truth dawned on me.

If you study the accompanying photographs one by one, I think you will understand how the sidewinder travels, without all the trouble I went through.

In the photograph of the tracks, the snake was progressing from left to right. Note that each track begins with the hammer-shaped mark at upper left. This is made by the head and neck. At the end of each track there is a T-shaped mark, which is made by the tail. Note also that there is no pushing up of the sand anywhere along the track



◄ EACH TRACK begins with a hammer-shaped mark (upper left) made by the head and neck. At the end of each track is a T-shaped mark made by the tail. Note that each track is the full length of the snake. Imprints of the belly scales show that there is no dragging or wriggling. There is no connection between the tracks, and each is the full length of the snake. This snake was moving from left to right but looping itself in the opposite direction from the one at right—"lefthandedly" it might be called.

as would be the case if traction were obtained in this way, which is seen in the wriggling movement of other snakes. The prints of the belly scales in the sand also prove that there was no sliding motion in the track. The tracks were made by pressure only from above.

Next, if we turn to the photograph of the snake in the process of making tracks, we can see how the trick is done. Here the subject is again moving from left to right but with its head toward the camera instead of away from it. (Note that sidewinders are not "righthanded" or "lefthanded." They can start off diagonally forward in either direction from a resting position.) Two tracks are always being made at once. The one in the center of the picture is nearly completed, while the one to the right and below has just been started.

Most important: only two parts of the snake are actually touching the sand. The central part of its body, and also its head, neck, and tail, are raised slightly. These parts are moved above the sand, while the two parts that are in the tracks support the whole weight of the snake and are momentarily stationary, just as each foot becomes stationary on the ground when a man is walking. But new parts of the body are constantly touching the ground. The segment that is in contact with the lower track is lifting out at the point nearest the neck and laying down farther along in the direction the snake is moving. At the same time, the hind part of the snake is lifting out of the upper track and flowing into the raised loop in the center, while the tail is being laid down.

This is illustrated in another way by the triple-exposure picture. This shows the snake in three successive positions in its progress — again, from left to right. The lower track is being completed, the upper has just been started. The picture had to be taken on black velvet instead of sand to get the multiple-exposure. The white lines have been drawn in to indicate where the tracks would be. Bear in mind that only those segments under the white lines touch the surface.

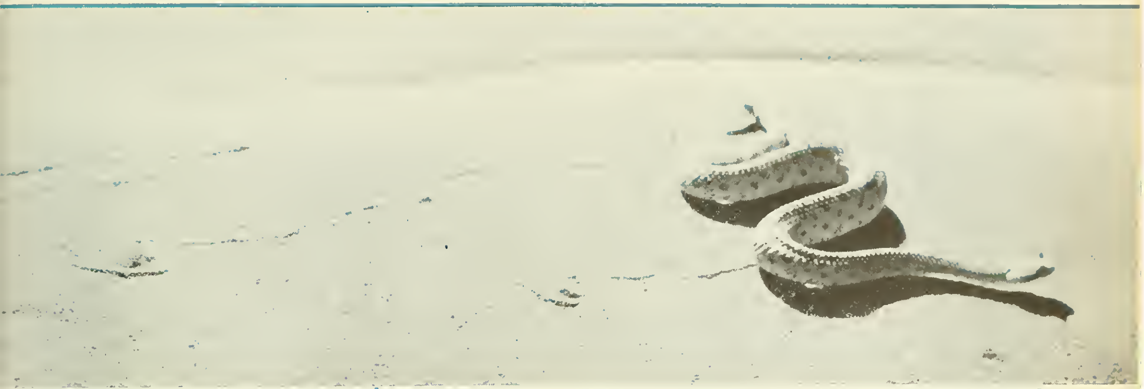
Another photograph shows how tracks similar to those of the sidewinder can be made by rolling a wire coil or helix, over the sand. For some readers this demonstration may make the movement clearer than the pictures of the snake do. Note how two tracks are made simultaneously and that a completed track measures the full length of the wire. Only the two segments of the helix are in the tracks at any one time. These segments progress with a rolling movement that is not identical with that of the snake but comparable. If you flatten out the central loop so that its motion is a sort of flowing rather than a rolling, you come closer to the sidewinder's movement.

Other snakes, if put on the sand, make only slow and awkward progress and expend great effort doing it. I tried a Prairie Rattler, a Bull Snake, and a Blue Racer. They are accustomed to surfaces that will offer friction as they wriggle along. On glass, a wriggling snake can scarcely move at all. The curves travel along its body but the snake stays in one spot, because glass offers no resistance to sidewise motion. But the sidewinder goes along on glass about as handily as on sand. This is because it needs only a surface that is fairly unyielding to pressure applied from above.

Other Winders

Other vipers that have evolved the sidewinding technique are found in the Sahara and Kalahari deserts of Africa and in the arid regions of southern Asia. That sidewinding should have developed in such widely separated parts of the world is a beautiful illustration of the efficiency of the evolutionary process. Where the need has arisen for an efficient way of moving over loose sand, natural selection has favored the snakes that tended to crawl like our Horned Rattlesnake of the Southwestern deserts.

The sidewinder also uses another totally different mode of locomotion called the "rectilinear glide." In this, the snake holds its body fully extended in a straight line, and the movement is much like that of an earthworm. There is a wavelike stretching and shortening of the body, while the belly scales serve to anchor one portion of the snake and then another. This meth-



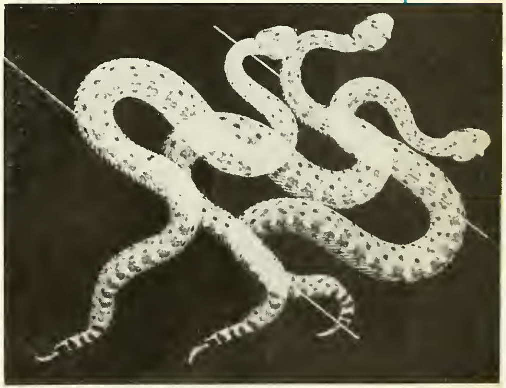
od is slower and probably not so efficient as sidewinding, but rattlesnakes do use it even in sand. Boas and pythons also use the "rectilinear glide."

In its "looping roll," however, the sidewinder has evolved a method that is not only unique but is as close to mechanical perfection as our imaginations can picture. You may see this for yourself someday if you are in the deserts of our Southwest or northwestern Mexico. The sidewinder does not frequent the haunts of man as a rule and is mostly active at night. You are not apt to see it in broad daylight, for hot sunshine will kill it in about ten minutes. The name Horned Rattlesnake comes from the pair of horns it has over its eyes, which may provide some protection against wind-blown sand. The sidewinder rarely reaches a length of three feet and is stouter than other rattlers. The females, unlike other snakes, are larger than the males. A row of dark blotches runs along the back against a ground color of cream, tan, pink, light brown, or gray, depending largely on the color of the snake's native sand. There are smaller dark spots along the sides.

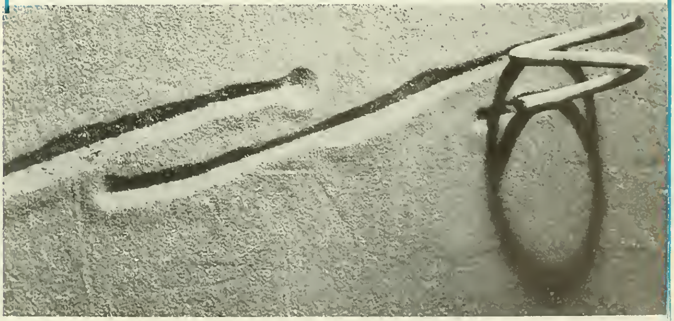
Though the sidewinder is poisonous, it is generally placid, and one can safely get close enough to watch it in motion. The performance is well worth witnessing. The reader may recall having seen it in Disney's motion picture, "The Living Desert."

▲ THE SECRET of the sidewinder's motion lies in the fact that only two parts of the body are in contact with the ground at once. The rest of the body is slightly raised above the surface. This snake, moving towards the right, is swinging its head forward while the two portions of its body that are in contact with the sand are laying down new tracks. The tail is about to complete the farther track, and the head will then start a new one.

➤ THIS TRIPLE-EXPOSURE of a snake progressing from left to right shows the successive positions of the body. The white lines are drawn in to show where the tracks would be made if the surface were sand instead of black velvet. Only the two parts of the snake under the white lines are in contact with the ground. All the rest is raised slightly.



▼ A COMPARISON of the tracks made by this helix may help to explain the motion of the sidewinder, though here the loop goes much farther above ground than the snake's.



Finding History UNDER THE SEA

The wrecks of vessels sunk centuries ago yield secrets of the era of colonial exploration

By

David A. Heller

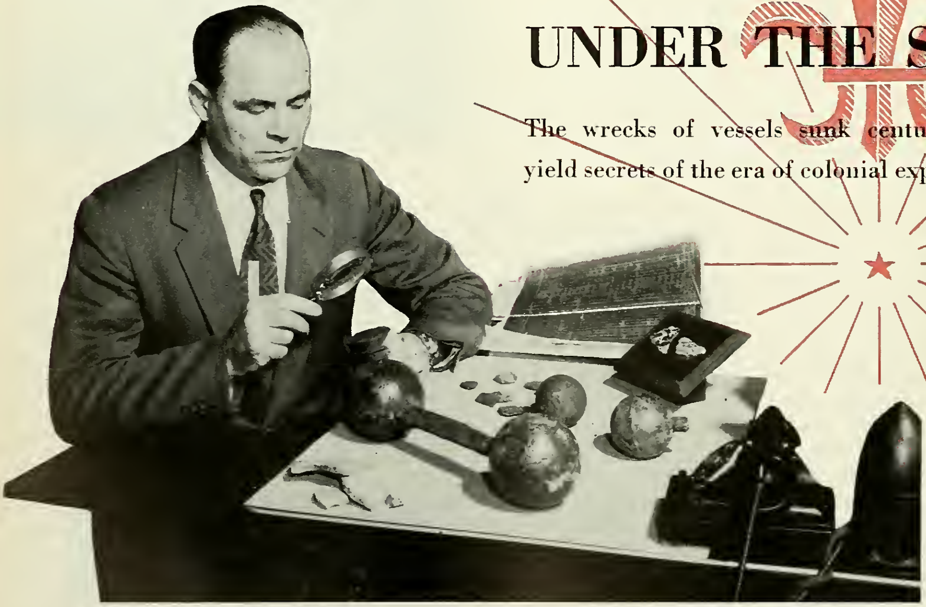
Smithsonian Institution photos

MENDEL L. PETERSON, Acting Head Curator of History at the world-famous Smithsonian Institution, is a historian with a brand new idea. We've been studying history on land for centuries, he says. Why not investigate some of the history under the sea? Acting on his own advice, Mr. Peterson has donned diving equipment and has explored many shipwrecks in the historic waters off our Florida Keys.

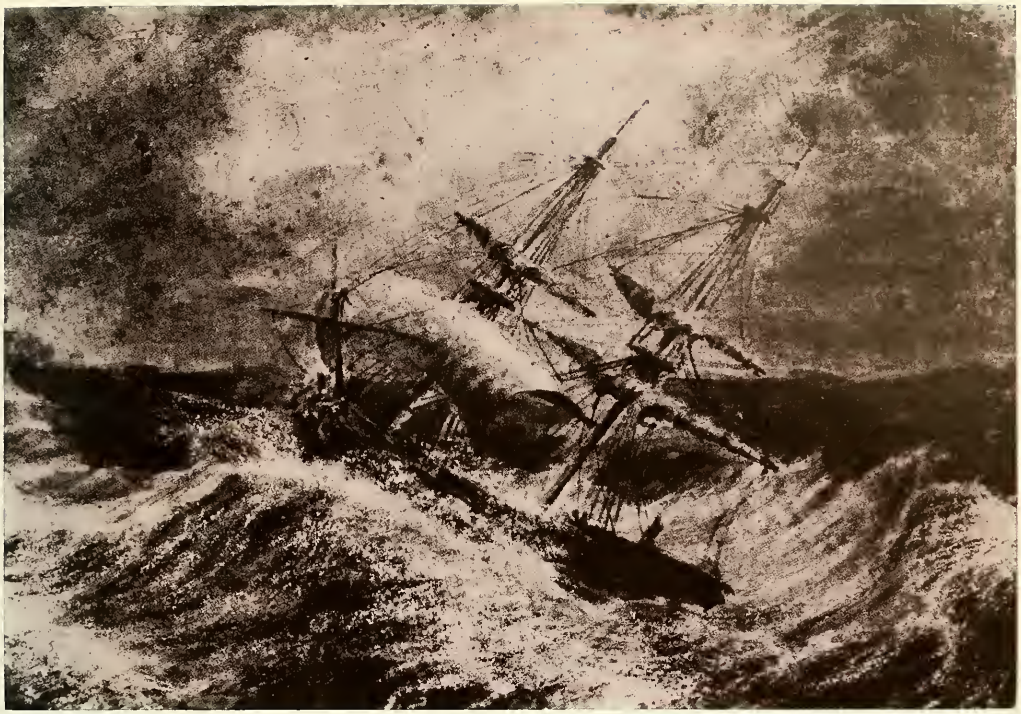
When Mr. Peterson was on active duty in the South Pacific as a Lieutenant in the United States Navy during World War II, one of his off-duty forms of relaxation was "dabbling around with shallow-water diving gear." Experimenting with diving equipment was nothing new for him. As a boy he built a diving helmet (strictly ineffective) using the altered gas tank of an automobile. Peterson never dreamed that his long-time interest in exploring the quiet green world under the ocean surface would ever amount to anything significant. Yet today, through an odd chain of circumstances, it is enriching our knowledge of our nation's stirring sea history.

All of this came about in an un-

▲ THE "SEA DIVER" is specially equipped with electronic instruments for locating ancient shipwrecks.



◄ MENDEL L. PETERSON at his desk, examining some of the relics he has brought up from wrecks.



▲ A TYPICAL SPANISH GALLEON of the seventeenth century like the ones Mendel L. Peterson and Edward A. Link have been searching for in their undersea studies.

usual way. In 1951, historian Peterson met Edward A. Link, President of the Link Aviation Corporation and developer of the Link Trainer, which has helped teach tens of thousands of pilots to fly.

Messrs. Link and Peterson met on the expedition of Dr. and Mrs. George Crile of Cleveland, which was exploring the remains of the shipwrecked British frigate "Looe." They became so fascinated with the many historically valuable items recovered from a watery grave that they resolved to go into undersea exploration on a systematic and regular basis. The Smithsonian Institution's Marine Archaeology project was born. Mr. Link underwrites the expense of the exploration, and his 65-foot specially equipped yacht "The Sea Diver" is used as a base of operations from which the expeditions proceed every summer. It is equipped with special diving gear and with electronic equipment for locating shipwreck sites.

The adventuresome role of an underwater historian is one that Mr. Peterson relishes. Every summer for the past four years, he has exchanged the scholarly atmosphere of his research library at the National Museum for a diving mask and swimming flippers to go on exploratory dives 35 feet or more beneath the surface of the coral reefs that dot Florida's Keys at the extreme southernmost tip of the United States.

Peterson, Link, and their associates are combing the Florida Straits for the wrecked remains of English, Spanish, and Dutch ships that went to the bottom centuries ago in the desperate struggle for domination of the newly-discovered American continent.

Finding wrecks is not easy, and even recognizing one after you have found it is a tough job. Think you might find it interesting to help ferret out the remains of ancient ships? Yes? Well, you'll probably be surprised at the way it's done in real life. The thing that might surprise you most is to know that you would probably swim right over the site of an undersea shipwreck and never even recognize it. Here's the way Mr. Peterson explains this:

"From the shipwrecks we read about in books of fiction, we might expect the vessel to be intact, though possibly listing to one side. Certainly we would expect the hull to be intact, with its masts erect and perhaps seaweed streaming from the rigging. An especially romantic account might even have the skeleton of the captain at the wheel.

"In real life, it doesn't work that way at all. The only trace of the wreck of a wooden ship over 100 years old is sand- or coral-covered metal objects. All exposed timbers have long since been destroyed by shipworms. Even metal objects like guns, coins, and cannon balls are camouflaged by nature and take on the exact color of their natural surroundings because of this coral coating."

If shipwrecks are so hard to recognize, how do the undersea historians go about their work?

"There are two ways to identify a shipwreck site," Peterson says. "The easiest is where an unidentified shipwreck is discovered by somebody — fishermen, sailors, or beachcombers, perhaps. Objects from it are salvaged, and its identity is established. The other and harder way is to attempt to locate a shipwreck site from ancient documents or charts describing it. We try to find as nearly as possible its exact location and then go hunting for it with electronic equipment.

"Modern science has made shipwreck hunting a lot easier. Among the aids we have are magnetometers so sensitive that they can detect the presence of iron under several feet of coral and sand. These instruments can also locate iron in water up to 40 feet deep. That's plenty deep enough, because shipwrecks are almost always in shallow water. If the water weren't shallow, there wouldn't be any wreck.

"Other twentieth century aids to investigating seventeenth and eighteenth century ships are sonar, fathometers, electronic detectors, and navigational aids which help us locate the remains and obtain exact fixes on shipwreck sites.

"Cannons are the usual guideposts to shipwrecks," Peterson says, "because they are big enough to be readily recognizable to the trained eye even when encrusted with coral sand."

Dead Ships Tell Tales

Two of the most interesting shipwrecks that Peterson and Link have worked on are the remains of the British frigate "Looe" and the remains of one of the vessels of "The Lost Spanish Fleet of 1733."

The site of the "Looe" was discovered by Mr. Bill Thompson of Marathon, Florida, and Dr. and Mrs. George Crile of Cleveland; and Peterson and Link were invited to participate in recovering objects from it. At the time of its discovery, the vessel was unidentified and nobody knew its story or how it met its disastrous fate. Identification was made possible by such objects as cannon inscribed with a crowned rose (a mark once used to indicate British Crown property), uniform buttons, a damaged Queen Anne period teapot, and scores of other objects.

After recognizing the ship, documents from the records of the British Admiralty gave its interesting story. In 1744, it was wrecked on the treacherous Florida reefs after being swept on the rocks by a strong current at night. It was escorting a captured Spanish vessel to Charleston, S. C. The "Looe" was set afire and burned by its captain after its crew found safety on a small island. That precaution was taken to prevent anything of value from falling into Spanish hands.

Once a yellowed navigation chart which Mr. Peterson located in the Library of Congress, plus dated silver pieces of eight dug up from the sand behind a reef, helped him identify another shipwreck as part of the lost Spanish fleet of 1733. The wreck had been discovered by Arthur McKee of Plantation, Florida.

"It was a treasure of historical material," Peterson declared. "Coins, forks, silver figurines, swords, muskets, small weapons, pewter bowls, porcelain, crockery jars, wine bottles, and even mahogany shoe heels were brought up from her."

The ship was one of eight lost in 1733 when a hurricane drove them upon the hard coral reefs of the Florida Keys as they were plying their way back to Spain loaded with riches.

Peterson declares that there are today, beneath the sand and coral of the Florida reefs, the remains of hundreds of ships of the sixteenth, seventeenth, and eighteenth centuries.

"These remains are a deposit of great historical importance," he says, "since in these sites will be found literally hundreds of objects of past centuries, many of them peculiar to maritime use and thus not found ashore."

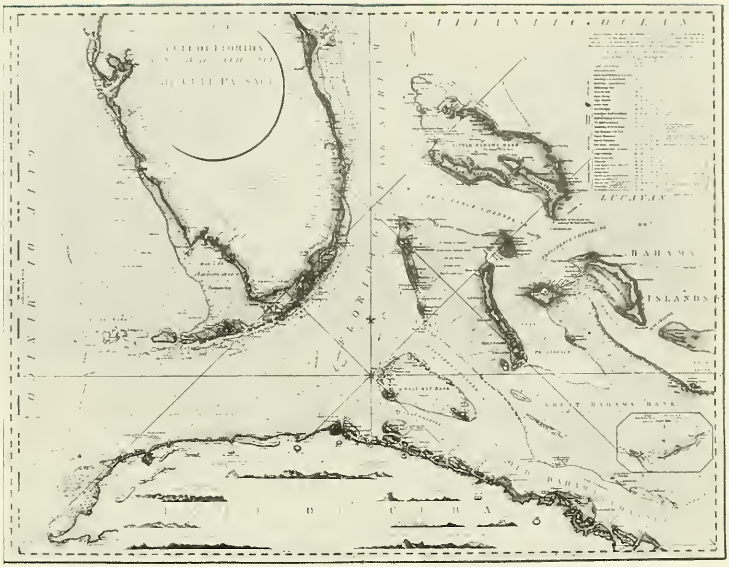
Sunken Treasure

While the Peterson-Link explorations are carried on to gain knowledge and not as a personal search for sunken treasure, there is little doubt that much treasure is there to be found—if one knows where to look.

"During the 300 years from 1520 to 1820, more than 8 billion dollars' worth of gold and silver were funneled through the Florida Straits to Spain," Mr. Peterson explains. "We know this because of Spanish tax records. Actually the figure was undoubtedly much larger, because many canny Spanish adventurers concealed their wealth to avoid the 20 per cent royal tax. A sizable amount of the wealth shipped back to Spain never reached its destination because the Bahamas were swarming with privateers, pirates, and the regular naval vessels of Spain's enemies. This, plus the treacherous navigation around the Florida Keys, took a terrible toll on Spanish shipping. In those days, about the only form of weather forecasting that seafaring men had was a wet finger held over the head to estimate wind direction or velocity. Sometimes the 'trick' knee of one of the officers gave warning of an approaching storm. It wasn't very reliable."

The National Museum has arranged a special display of some of the hundreds of objects recovered by the expeditions of its Marine Archaeology project and by other expeditions in which Peterson has participated. It hopes that a systematic program of study, exploration, and recovery of objects obtained from these shipwrecks will broaden our understanding of the stirring drama of America's early sea history.

➤ **An old chart** of the Florida Straits and adjacent waters, the area in which Mendel L. Peterson and E. A. Link are carrying out their diving operations. It was in this region that bloody sea battles were fought for the possession of the treasures of the new world.



➤ **E. A. Link** on the "Sea Diver," with a coral encrusted cannon raised from the sea floor from a wreck in the Florida Keys.

➤ **Mendel L. Peterson** inspecting a 2,000-pound cannon salvaged from a Spanish ship wrecked in 1733. Modern light-weight diving equipment has greatly spurred exploration of the sea floor.

➤ **The Acting Curator of History** at the Smithsonian Institution, searching for objects of historical value on the site of a wreck in the Florida Keys.

nature unspoiled

In the shadows
of the skyscrapers
of New York,
a primeval forest
has been preserved

Mianus Gorge

WHEN we see cities merging into cities, with the loss of all traces of the natural landscape, we think of Mrs. Anthony Anable and the Mianus River Gorge in Stamford, Conn. Here, almost in the shadows of the skscrapers of New York City, one of the finest remaining examples of virgin forest in eastern United States looks down on one of the most heavily congested areas in the world.

When Gloria Hollister Anable discovered the wonders of Mianus, she dreamed of saving it for scientific and public enjoyment. Before her marriage, she had majored in zoology in Connecticut College and Columbia Univ. and had worked with William Beebe. Through many trips to the Gorge, she came to know its plant and animal life better than most of us know our own backyards. She brought her husband and friends. A field trip with a group of experts in conservation, including Richard H. Pough of the American Museum and Richard H. Goodwin, Chairman of Natural Areas of Conn., convinced her that the preservation of Mianus River Gorge was an objective worth working for.

Last Christmas the bulldozer threatened to move in and strip the timber. The owner of an important section would have profited financially by selling the land to developers, but his sympathy for preserving the area as a natural spot was enlisted and the sale was staved off.

The Mianus River Gorge Conservation Committee of the Nature Conservancy was then formed, and Mrs. Anable's enthusiasm kindled fire. She was overwhelmed by the help she received from Garden Clubs, Audubon Societies, the Boy Scouts and Girl Scouts, and more than 600 contributors. June 1, 1955 was a red-letter day, for they then had the money to purchase a 60-acre tract. Public-spirited citizens are donating approximately 65 more. They envision the final area as containing between 200 and 300 acres.

The Mianus River Gorge has an interesting geological history. Many millions of years ago, during the last Ice Age, several miles of the Gorge were gouged out of the granite hills by the movement of great masses of ice. With the retreat of the ice, the magnificent cliffs that were formed became covered with a mixed climax forest of deciduous trees and centuries-old hemlocks—the climax in all the succession of plant dynasties that took over in the wake of the receding Ice Sheet. Primitive Indians of the Mianus tribe fished from the deep pools between the swirling rapids and cascades of the Mianus River. Here, too, early white settlers, seeking the hinterland, followed the narrow trail from Long Island Sound all the way through the rugged Gorge. Like the Indians, they lived by fishing and hunting in the heavily wooded forests along the banks.

When we enter this forest, we face realities we do not find in a noisy city. Our gaze goes up to the tops of the 125-foot hemlocks and down to the beautiful ferns and Indian pipes at our feet. The smell is clean and fresh. Thriving on the forest floor are masses of dainty ground pine, orchids, wintergreen, and mushrooms of all shapes, sizes, and colors. In spring, the whole landscape is alive with a profusion of wild flowers.

A minister recently said that the program of setting aside samples of the world's different plant-animal communities in order that a few examples of each type may escape the rising flood of urban congestion reminded him of Noah and God's instructions to Noah on filling the ark.

Richard H. Pough says "The hemlocks in the gorge guard a wealth of scientific data. Secrets of climate, the evolution of plants and wildlife, mysteries of soil and water, are hidden in this unexploited wilderness. Through the study of biotic communities like this, scientists may add immeasurably to their knowledge. Through contact with its beauties, man may add immeasurably to his stature."

NATURAL HISTORY praises Mrs. Anthony Anable and the Mianus River Gorge Conservation Committee for their accomplishment in a field of community betterment that presents opportunities in many towns and cities throughout the country.

They sought out the burrows of the insects, and when the openings were reached, the birds thrust their long spearlike tongues far down into the tunnels to pierce and retrieve the luckless grubs.

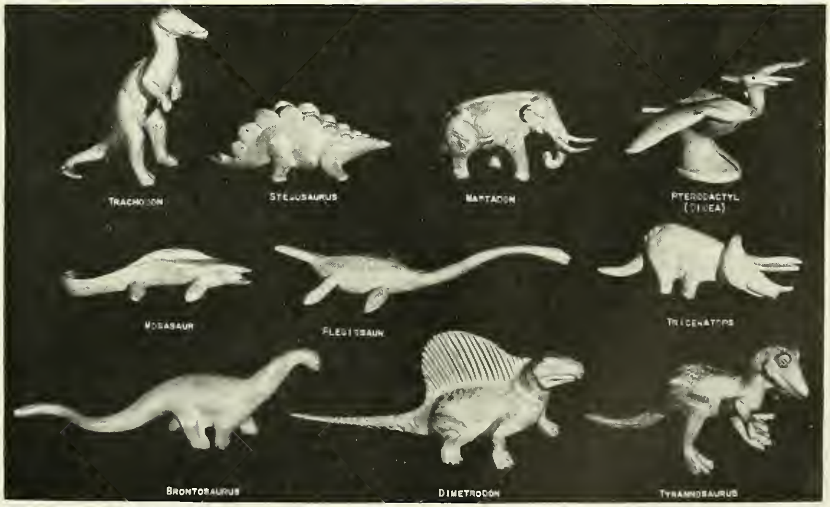
It would seem that an insect that was endowed by Nature with the ability to bore through solid oak would be immune to most enemies, but the truth is that, in addition to the woodpeckers, they had many mortal foes. Those that excavated their burrows through the great oak were plagued by wasp parasites of various kinds. One of these was the Thalessa wasp. It was a large ichneumon wasp that possessed long, threadlike stylets with which it could drill a shaft deep into the solid wood and deposit an egg in the boring larva of the pigeon tremex.

And so life was again developing within the great tree. It was a world made up, to be sure, of numberless individual bits of life each with a separate destiny, yet each was a part of the tree, for the body of the tree had nourished it.

One day in early summer there came a worker honeybee to the oak. To all appearances it was just an ordinary bee, but actually it was an emissary from a great swarm that hung as a cluster of seething insects from the limb of a tree a mile away across the river. This scout bee was seeking a suitable location for the swarm; a tree cavity, perhaps, where the teeming throng of her sisters and their queen might establish a home. Carefully she explored the oak from top to bottom, searching out each crevice that might lead to a hidden cavity within.

At last, 25 feet from the ground, the scout bee found a knothole that opened into a large, hidden cavity. The scout bee explored this cavity minutely and then flew back across the river to the swarm. Other scout bees soon returned from other directions, and as soon as each arrived, it began to do a strange gyrating dance which indicated to the other bees the location of the discoveries. Each scout performed its dance with a degree of enthusiasm that presumably indicated the desirability of the new quarters that it had scouted.

The bee that had explored the cavity in the dead oak won out, and soon the entire cluster of honeybees numbering many thousands took off in massed flight and streamed into the knothole in the great tree. Shortly there were combs under construction containing thousands of hexagonal cells that were marvels of geometrical perfection. With the dawn of each day, the field bees left the colony



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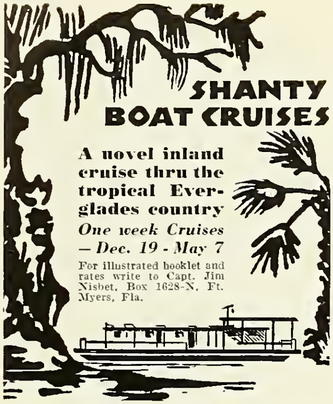

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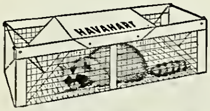

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by way of the knothole and traveled far afield in search of nectar and pollen, and so the colony thrived, secure in its feudal stronghold. But the bees knew or were conditioned by instinct to the fact that summer would not last forever, and so they stored up honey against the time when the frost would kill the nectar-bearing flowers in the fields beyond the woods.

Thus the first summer passed, and the teeming and varied life within the body of the oak settled down to pass the cold season of winter, each after its custom.

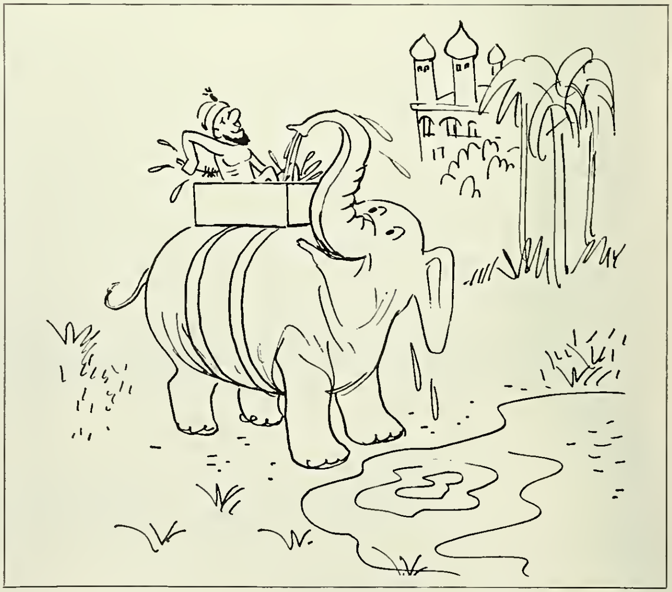
Soon a white snow blanket muffled the land, and frigid winds beat against the sides of the tree. When the temperature dropped low, the semidry wood of the tree snapped with the pressures of contraction. Inside, however, the creatures that called it home were secure, for they were protected by the solid mass of the oaken walls.

So the winter passed and warm spring rains began to saturate the dead oak. The tree in general was still solid, but the tunnels from the previous year allowed water to penetrate to the heartwood, and soon molds and fungi were spreading their mycelia throughout the tree.

With the coming of spring, life in the lowlands began to throb anew, and in every leaf and twig the life processes commenced to flow again. Mated queen termites found the oak, and soon there were streams of blind worker termites excavating their tunnels and feeding upon the wood.

This second year, the oak no longer was attractive to the ambrosia beetles, which instead sought out other freshly dead trees in which to grow their fungus gardens. New kinds of insects now attacked the oak in place of the ones of the previous year. Borers in endless variety drove their galleries through the wood, and heaps of sawdust accumulated about the tree's base. Pieces of bark became dislodged and fell away, exposing the lighter wood beneath. High up near the topmost branches, pileated woodpeckers began to chisel into the softening wood, making squarish entrance holes to their nest cavities, where they laid white eggs.

Truly, the forces of nature were busily at work converting the crumbling tree into other forms of

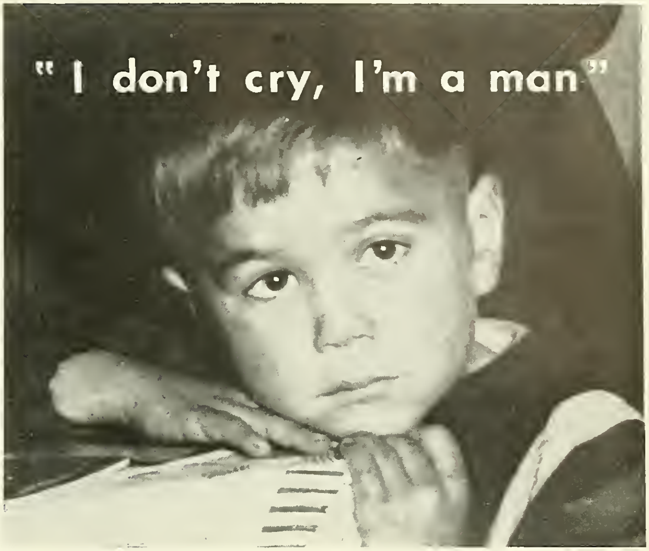


life. The tempo was faster now with the combined action of the fungi, the insects, the birds, and the weather.

Soon it was summer's end again, and each night the constellations of autumn marched across the roof of the forest led by Pegasus, the winged horse. Autumn brought the hunter to the woods; it also brought the season of gales. There came a day when violent winds lashed with elemental force against the towering hulk, and slowly the huge oaken mass swayed and then sank, as if in slow motion, and the earth trembled under the impact of its tremendous weight. The sounds of the crash echoed through the forest, and then night came to shroud the prostrate tree.

Winter acted out its last charade, and spring again answered the curtain call with its pageant of burgeoning color. The oak lay in intimate contact with the moist earth, and molds and fungi of amazing kinds and hues developed upon the decaying wood and dusted their brilliantly colored spores over its surface. Passalid beetles excavated their tunnels through the soft, spongy material that was once solid wood, and deer mice with quivering noses explored the damp passages. Soon they had built their nests and were rearing their young. When the full moon hung like a great yellow ball over the forest, they made little seed-gathering excursions into the surrounding weed patches, and hunting owls often came through the night on muffled wings to snatch the tiny creatures from their runways.

Soon all that was left of the oak was a soft, yielding, spongy mass, but to the mice, beetles, and other creatures it was home. This was the final chapter in the saga of the oak; a story that had begun when a tiny acorn sprouted in the soft humus beside the river. It was the story of a tree that in life and beyond had furnished food and shelter to an endless array of fellow travelers along the meandering path of time.



" I don't cry, I'm a man "

Motherless little Klaus never cries—though he's often sad-eyed and pensive. The six-year old boy has known much misery ever since his family was forced to flee East Germany with only the clothes on their backs. After months of wandering, they found refuge in a West German village. Then his mother died.

Although Klaus misses his mother terribly, much of his listlessness is the result of malnutrition. Often, there is very little food in the primitive shed where he lives with his father. Recuperating from a serious operation, the father can earn only a few pennies a day doing odd jobs. He is fighting valiantly to keep Klaus and to bring him up to be a good citizen.

To take this sensitive, imaginative boy from his father would be too cruel. Klaus shows talent. He has no toys, so he sprawls on the ground and spends hours drawing pictures in the dust with a stick. Perhaps he will grow up to be an artist . . . an architect . . . an engineer. In time, the father will be able to work again as a truck driver, will be able to afford better living quarters and good nourishing food. Until then, you can help keep them together, help make Klaus' future secure.

HOW YOU CAN HELP KLAUS

You can help Klaus or another needy child through the Child Sponsorship Plan of Save the Children Federation. By undertaking a sponsorship, you will provide funds to purchase food, warm clothing, bedding, school supplies—even candy for "your" child. The cost is only $120 a year, just $10 a month. Full information about the child you sponsor and a photograph will be sent to you. You may correspond with "your" child and his family, so that your generous material aid becomes part of a larger gift of understanding and friendship.

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NH-11

continued from page 461

ers get as docile as old milk cows, particularly the Black Widows.

When we want to silk a spider, we remove her from her jar as carefully as possible, lest she become excited and injure herself struggling to get free. We are also careful not to destroy her orb, particularly if she is a large adult and too heavy to be agile at weaving. She would tire herself needlessly building a new one.

Fresh spiders are used for each order, and we always allow a few days rest before silking them again. When they become old and are nearing the end of their life span, we must remove them from among the producers, for though they can still make silk they do it feebly and the strands do not have the required strength. Evidently, as with humans, their glands do not function properly in old age.

Most of our spiders live less than a year, so we are continuously replenishing the supply. Some we raise from the egg sac; others we collect; still others are donated About half of our adults are reared in the spidery.

The principal reason for raising spiders is that this is the easiest way to keep on hand a supply of spiderlings for extremely fine webs.

The breeding cycle of the Banded Garden Spider begins when the adult female lays 300 to 400 eggs in the fall, encasing them in round egg sacs. The eggs hatch during the winter and the spiderlings remain within the sacs for some time before emerging. They do not grow perceptibly during this period, although they do feed upon one another. We often force them to emerge prematurely by pulling the egg sacs apart. Then we put them into warm cages and provide abundant food to make them grow faster. In a typical spring, we may have on hand 100 adult spiders and 10,000 young ones just emerging.

The cages for the spiderlings have a wood frame, a glass front, and gauze at the sides and back. A circle is cut out of the bottom of each cage so that it can be placed over a potted plant infested with aphids (plant lice)—the spiderlings first food. After they have grown a little, we move them to larger quarters and introduce a diet of fruit flies. Later, when the spiders have grown too big to escape through wire mesh, we place them in large, screened cages and feed them insects we obtain by sweeping the grounds with a net. When nearing maturity, each spider is placed in its own glass jar and fed home-grown meal worms.

The mortality rate is extremely high. Out of the thousands of spiders that emerge each spring, we are lucky to rear 40 or 50 to adulthood. First, there is cannibalism. If the spiderlings were free, the brood would scatter after a very short time; but, confined, they feed upon each other. Then many are lost during the moults. In the hot summer months, well-fed spiders grow rapidly and moult frequently. Some individuals seem to lack the fluid that softens the old skin and die when they are unable to shed it. (Older spiders seem to have more difficulty extricating themselves than young ones.) Others are injured during the moulting process. The legs are very wet and soft at first, and the spiders must hang from their old skins by the tips of their feet until they have completely dried. The larger ones frequently fall too soon, injuring themselves, so that their legs dry bent and twisted.

Despite the careful handling we give them, we lose a number of spiders during the silking process. The biggest problem is trying to keep them from pulling off their own legs. Gruesome as this sounds, it is not fatal to spiders; on the contrary, is their means of escaping enemies—up to a point. Most spiders can lose at least two legs without being severely crippled. Nature has provided them with a "weak link" in each of their seven-segmented legs which facilitates "bloodless" amputation. They regenerate smaller but perfectly usable legs at their next moulting. Unfortunately, some spiders struggle so frantically that they cripple themselves beyond rejuvenation.

The old-timers become so "tame" after successive silkings that we have very little trouble with them.

Spiders may not "recognize," but they certainly become accustomed to handling and silking. I do not believe that everyone could put their hands into the jars, remove the Black Widows, and allow them to crawl over the hands and arms without being bitten as I have done for years. This is not necessary to the silking process, but I have persistently done it to prove that they positively will not "attack."

The three species we use differ not only in habits and adaptability but also in disposition. Aranea refuses to make her orb in small quarters. She simply *sits*, looking like a bump on a log, until suitable space is provided. She is the only one bold enough to take an insect from tweezers and can be quite belligerent about it. Sometimes there is an audible click of her fangs against the tweezers as she pounces and bites.

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The Banded Garden Spider, unless she is heavy with eggs, will improvise an orb in a very small jar and is always ready to eat anything that is dropped to her, even in the daylight. But at silking time she is harder to manage without injury than the others.

The Black Widow, despite her reputation, is the gentlest of the three. When she is held by the feet with tweezers, she will, of course, try to pull off her legs unless care is used. But she will struggle to the last to free herself, rather than attempt to bite. Neither Ray nor I have ever been bitten.

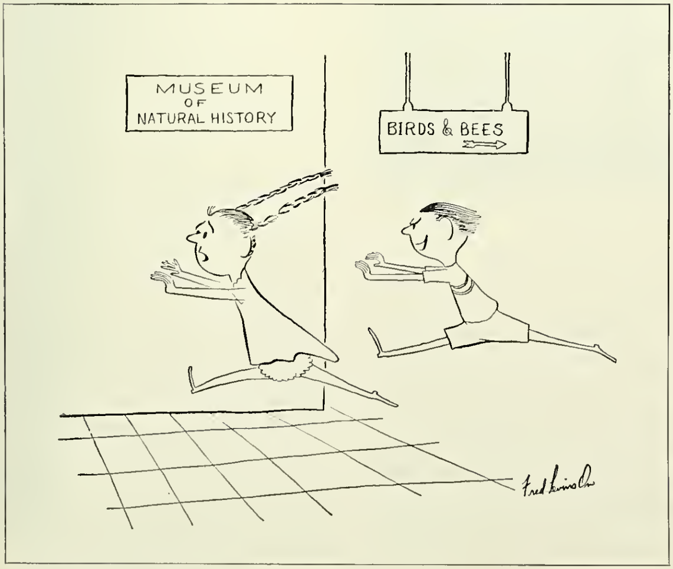
We are fully aware, however, that Black Widow venom, though small in quantity, is many times more deadly than the venom of a rattlesnake. It affects the nervous system in the manner of cobra venom. Even the tiny drop that the Widow can inject is potent enough to produce severe systemic symptoms and, on very rare occasions, death.

We did not adopt the Black Widows out of an attempt at bravado but only after we learned that the large orb weavers die off in the fall after their eggs have been laid. Orders were coming in, and we were out of spiders. So we tackled the Black Widow as the only large aerial web-spinner that naturally lives through the winter months in the adult stage. Its web proved to be the strongest obtainable of its size (about 1/7000 of an inch). The U. S. Army and Navy, now procuring their own web for repairing their instruments, use Black Widows exclusively.

Living and working with spiders has never produced much in the way of monetary return. The most earned in one month was $300. It has been chiefly rewarding in that it has provided us with an intimate understanding of some of nature's most remarkably specialized creatures and has allowed us to make worthwhile contributions to the knowledge about them.

Quite recently, Ray's business interests prompted us to move our spidery from Yucaipa to a cabin near Lake Tahoe in the mountains of Nevada, where we are now nicely and permanently established, spiders and all.

The move provided the first real vacation I have had in 15 years. During all that time I could never find any capable person who cared to "baby-spider-sit."



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Photographs from
Nat Fein's Animals

BOOKS *continued from page 455*

ference, an ancestral grizzly, which, of course, it is not.

However, with so many of these large carnivores to write about, and natural science has recognized several score of species and subspecies, McCracken has dug deep into literature and folklore and brought together much interesting data. He has himself hunted both the grizzly, in the restricted sense, and the Alaskan brown bear and has observed them in substantial numbers and under conditions favorable to observation.

The big bears of the plains and of the Rocky Mountain regions have been featured in Indian legends and were subjects of much interest to the early white explorers, such as Lewis and Clark. From earliest times, the grizzly has stood at the top of the big game list, and it is to be deplored that too much of the interest in this animal has been directed at killing him.

Today grizzlies have disappeared from many of their historical haunts and in many other regions are faced with extinction. If this book can direct attention to the need of more conservational thinking about these magnificent mammals and less emphasis upon how they may be destroyed, it will have accomplished much.

HAROLD E. ANTHONY

NAT FEIN'S ANIMALS

Gilbert Press, $3.50
95 pp., 60 photos

AMONG other things, modern America is a land of stampeding photographers, and a large part of the nation has become hysterical over nature pictures.

The fulfillment of the camera artist's dream is not only to get action but to capture some sensitive expression in the face of an individual that pauses for a moment and is gone. Somehow, in each of his pictures Nat Fein has managed to be alert at the crucial moment and to get these fleeting expressions of individualism.

Here, as Walt Kelly puts it in the foreword, "is a morning full of pictures by Nat Fein, some sweet, some bright. all friendly . . . despite the fact that there is neither 'possum nor alligator in the lot."

Perhaps the best way to praise Nat Fein's animal book is to say that he is a Pulitzer-prize winning photographer, and the collection here includes some of his greatest pictures with his own stories of how he got them. Nat Fein is not one of those crazy photographers that never stirs without a camera to his shoulder. He is one of the rugged breed of news photographers that takes his work seriously, never sparing time or effort in getting his picture and a character portrait at that. *Nat Fein's Animals* has an enlightening foreword by Walt (Pogo) Kelly and an introduction by Ferdi Barker and Ruth Biemiller.

George G. Goodwin

SEEING AMERICA'S WILDLIFE

--------- by Devereux Butcher

The Devin-Adair Company,
Cloth $5.00—Paper $2.50
338 pp., 350 Halftone illus.

THIS is a Baedecker of the National Wildlife Refuges, which are administered by the Fish and Wildlife Service to help prevent extinction of certain native birds and mammals. Forty-one of these, as well as a number of other areas, are described; and the more important animals, for whose protection the areas were selected, are introduced to the reader and pictured in many beautiful halftone engravings. The author has traveled widely throughout the United States, is familiar at first hand with the scenes and creatures he describes, and is an able photographer. He is a conservationist and makes an earnest plea for preserving on behalf of future generations at least some of the splendid wildlife that time has left in our charge. Most readers, I am certain, will agree with him that our children and grandchildren will suffer a grave loss if deprived of the inspiration, recreation, and relaxation we may secure today in the undisturbed natural areas.

The bulk of the book takes up the areas one by one, tells where they are located, how to get there, where to stay, and features the species of particular interest or significance in the area. Because the selection of these refuges is patterned upon the threat to certain mammals and birds, their location on a map of the United States shows wide expanses without refuges, either because it is too late to save a former resident such as the extinct passenger pigeon, heath hen, or Carolina paroquet, or because there is no notable concentration or critical situation calling for a refuge.

From the nature-lover and the person who likes to visit regions of particular wildlife interest, this book will receive a warm welcome.

Harold E. Anthony

THE PEOPLE OF THE SIERRA

--------- by J. A. Pitt-Rivers

Criterion Books, $4.00
232 pp., 8 illus.

JULIAN Pitt-Rivers is a rather rare specimen: in the newest of the social sciences he is a third generation anthropologist. His great-grandfather, General L. F. Pitt-Rivers was one of the founders of the anthropology department at Oxford University. His father, Captain G. H. L. F. Pitt-Rivers wrote a book on the peoples of the Pacific that is counted an anthropological classic.

But although Julian Pitt-Rivers comes to anthropology, so to speak, by heredity, his interests represent one of the most recent trends in the science. Traditionally, the anthropologist has concerned himself with primitive people. Someone once described him facetiously as a specialist in people who go barefoot. More recently, the anthropologist has broadened his field to include people of his own cultural background, and today the French or the Irish are considered as fair game for study as the Zulu or the Eskimo.

The People of the Sierra examines the beliefs and customs of the natives living in the rural community of Alcalá in Andalusia, southern Spain. Because of the touchy nature of Spanish politics, the name of the town is fictitious, but the people are real, and Pitt-Rivers writes about them with feeling and authority. He lived in their mountain village for three years, and his friends and associates were herdsmen, farmers and housewives, doctors, lawyers, priests, and politicians. Others who contributed to his understanding of rural Spanish life were bandits, smugglers, witches, and gypsies.

To those who would understand modern Latin America, this study of the Spanish homeland is a must, for within the framework of one small Andalusian town the author lays bare age-old personality characteristics, values, and forces that are still active in our neighboring Spanish American Republics from Mexico to Chile. While intended primarily for the specialist, this book is clear, straight-forward, and thoroughly readable.

Harry Tschopik, Jr.

INDIAN SKETCHES

taken during an expedition to the
Pawnee Tribes (1833)

-------- by John Treat Irving, Jr.

Edited and annotated by
John Francis McDermott
University of Oklahoma Press, $5.00
275 pp., 16 illus., 1 map.

AT THE age of twenty, John Treat Irving, Jr., a recent graduate of Columbia University, set out in 1833 to explore the territory of the fierce Pawnee Indians who then roamed the prairies between the Platte and Kansas Rivers. His interests in the wonders of the West had been stimulated by his illustrious uncle, Washington Irving (affectionately referred to in the journal as "Uncle Wash"). It was his uncle, also, who was instrumental in arranging for the boy to accompany the second expedition of the Indian Treaty Commission, whose task it was to straighten out the numerous problems caused by the removal of Indian tribes within the United States to what was then Indian Territory.

Indian Sketches is not the most important chronicle of western exploration written during the early nineteenth century, but it is certainly one of the most entertaining. Young Irving was fascinated by everything he saw, and his narrative is fresh, vigorous, and unsentimental. Almost nothing escaped his keen observation. He found time to note the beauty of prairie wild flowers, the thieving habits of Indian dogs, and the grandeur of western landscapes. The Indians themselves he saw as human beings — neither as objects of contempt nor as romantic savages. His sly sense of humor, which pervades the journal, led him to characterize one Oto chief as "rather good natured, but gifted with a large supply of mulish obstinacy, and a temper like gunpowder."

In mood, the narrative is frequently exciting, as when Irving experiences his first welcome by untamed Plains Indians. Some passages, such as the description of the arrow sacrifice of a captive Cheyenne girl, are downright blood-curdling. Others, as when the young explorer, lost in the vicinity of what is now Topeka, Kansas, persuades a suspicious and reluctant Indian to ride him across the Kansas River, are highly amusing.

Editor McDermott has provided useful notes and bibliography.

Harry Tschopik, Jr.

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With the Explorers

Fossil Link Between Reptiles and Mammals

A fossil collection made during the summer by an American Museum expedition in Arizona should prove to be one of the most significant in the history of backboned animals, according to Dr. Edwin H. Colbert, Curator of Fossil Reptiles and Amphibians at the Museum and leader of the expedition. The collection includes at least a dozen skulls and several skeletons of the animals that have long been thought of as the "Missing Link" between fossil reptiles and mammals.

These animals are about the size of our modern domestic cat and are called tritylodonts. They lived about 175 million years ago, during the upper Triassic. Until recently, they had not been found in the Western Hemisphere. A few skulls, skeletal bones, and fragments had been found in such diverse places as South Africa, China, and England.

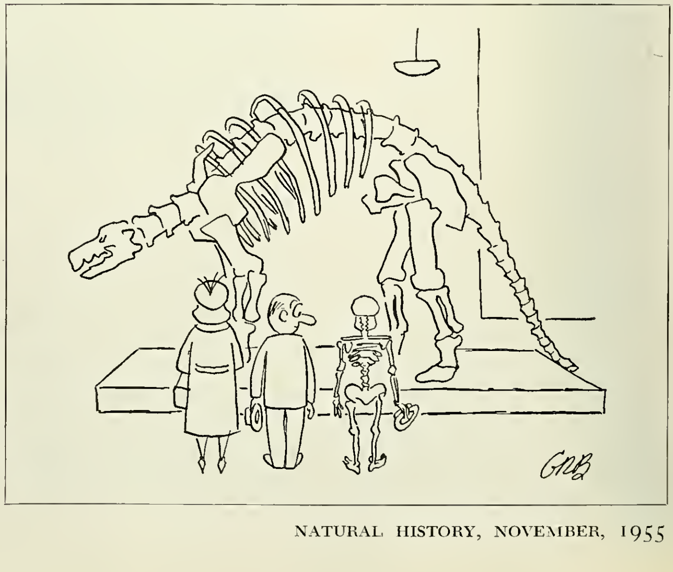
The first evidences of tritylodonts in this hemisphere were discovered in 1953 by Mr. Ben Hoy, a government soil conservation engineer, who found some bones weathering out of a sandstone deposit in Monument Valley, near Kayenta, Arizona. Excavations made the following year by the U. S. Geological Survey under the direction of Dr. G. Edward Lewis proved the bones to be those of the long sought-after animals. Dr. Lewis and his associates removed several skulls and skeletons from the site.

By arrangement with Dr. Lewis and in co-operation with the U. S. Geological Survey, Dr. Colbert's party went to Monument Valley to try to make a collection for the American Museum. After carefully surveying the area, they found a concentration of tritylodont material close to the spot where Dr. Lewis had worked. The skulls included those of some very young animals, which will enable the scientists to study growth and development within the species.

Tritylodonts had the multiple-boned lower jaw of the typical reptile but multiple-cusped teeth common to mammals. "They belonged to the most advanced group of mammal-like reptiles, the ictidosaurs," said Dr. Colbert. "These animals had almost crossed the threshold separating reptiles from mammals. In some ways, they were rather rodent-like. Evidently the lower jaw moved forward and backward when the jaws were closed, thus grinding food between the teeth in somewhat the same fashion as do some of the modern rodents. When the fossils are extracted from the sandstone matrix and studied, we hope to know a great deal more not only about these animals but also about evolution as a whole."

Teton Wilderness Area

More than half a million acres within the Teton National Forest in western Wyoming has been designated as the Teton Wilderness Area by the U. S. Department of Agriculture. The area straddles the Continental Divide and is adjacent to Yellowstone National Park. It will be managed so as to preserve its natural primitive conditions, the Department of Agriculture reports. No roads, sales of timber, or other activities contrary to this objective will be authorized.



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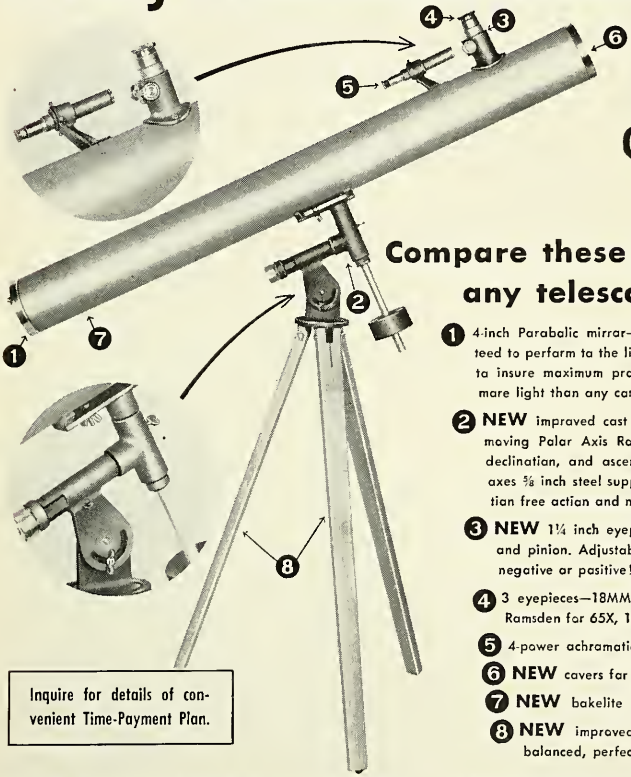

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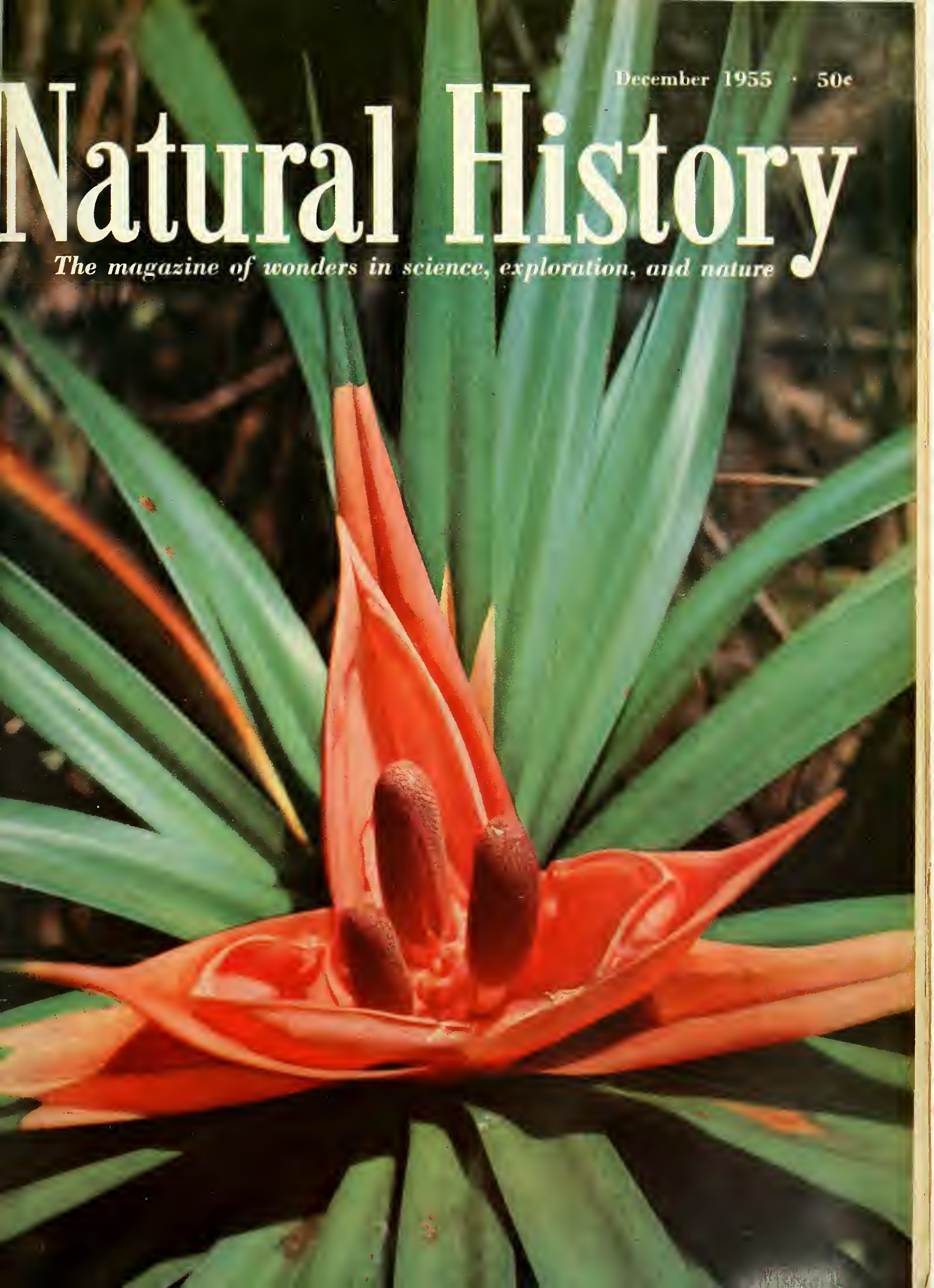

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THE MUSEUM SHOP

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Letters

Praise the Dance

SIRS:

It certainly is heartening to learn from Hugh Tracey's article on the Nazareth Zulus that Christian natives in Africa do not discard their own traditional dances. It would not be Africa without the drums and dances. Perhaps the Zulu preacher read the 150th chapter of Psalms, especially the fourth verse: "Praise him with the timbrel and dance." . . .

CECIL A. YOUNG

Houston, Tex.

Primitive Recipe

SIRS:

I am interested in collecting "primitive" recipes requiring few ingredients – especially those using corn as an ingredient. Many ethnological texts mention dishes, but rarely does an author give recipes. Can any of your readers furnish practical recipes for the Zuñi wafer breads mentioned in Cushing's "Zuñi Breadstuff," as well as the "Dulce de Garbanzo," mentioned by McBryde in his books on the Guatemalan Indian. Also, Korean Kimshi, and bread made of lupini beans.

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▲ NOSE-ON VIEW of a tame Asiatic otter (*Lutra lutra barong*) photographed by Y. G. A. la Bartide of Timor, Indonesia.

Conservation News

Our Tallest Bird

The Whooping Crane population has been hovering around the two-dozen mark. Earlier this autumn, people from Canada to southern Texas were urged to ensure safe passage for the remaining birds during their 5000-mile migration to the Aransas National Wildlife Refuge. The Whooping Crane is one of the world's rarest birds.

Three of the large birds were known to have been brought down recently by hunters, leaving no doubt as to the danger they face during flight. One of these was found wounded on the Gulf Coast of Louisiana. Another was discovered alive but injured in Kansas. And the third, another gunshot victim, was found on the plains of Saskatchewan, Canada. After all efforts to keep the wounded birds alive failed, they became the scientific property of Southern Illinois University's zoologist Harvey I. Fisher. Dr. Fisher is one of the country's leading bird anatomists. His special interest is in recording information about dwindling species before they become extinct. He has previously worked on the California Condor, of which about 100 individuals remain. Although much has been learned concerning the migration, feeding, and nesting habits of the Whooping Crane in the effort to discover ways of protecting it, no thorough examination of its anatomy has been completed. Dr. Fisher's book on the anatomy of the Whooping Crane, produced in co-authorship with D. C. Goodman, will be published by the University of Illinois Press.

In the fall of 1954, no young birds accompanied the 21 adults that arrived at the Aransas preserve, the winter refuge of the threatened bird. Then the U. S. Strategic Air Command pressed their plan to establish a photoflash bombing range near the southern boundary of the refuge. This was regarded by conservationists as equivalent to almost certain extinction of the Whooping Crane. Public opposition, together with protests from the Canadian Government and the United States Department of the Interior, succeeded recently in causing the Strategic Air Command to drop this plan.

For the last 33 years, mystery has surrounded the actual location of the Whooping Cranes' subarctic breeding ground. But on May 18th, 1955, William A. Fuller, biologist of the Canadian Wildlife Service, while flying low over the Sass River with Edward Wellein and Wesley Newcomb of the U. S. Fish and Wildlife Service, spotted a pair of Whoopers and a nest. A few miles farther north, a second pair of birds was seen, and on the Klewi River a third nest with one egg and one Crane came into view. Within less than two weeks, Robert P. Allen, leading authority on the Whooping Crane, slogged through tangled thickets and log jams to the spot north of the 60th parallel to meet the Whoopers on their own ground. For ten days he and Raymond Stewart of the Canadian Wildlife Service studied the nesting habitat, seeking hints as to what may have been preventing the birds from raising their young. Most heartening event of their investigations was the sighting from an airplane of two sets of Whooper twins in the nesting grounds. Mr. Allen and his flying companion John O'Reilly are the only two men in the world who have seen Whooping Crane families both on their wintering grounds in Texas and their nesting grounds in northern Canada.

The aim of recent publicity in Canada and this country has been to ensure the safe passage of these birds in migration. Their traditional route carries them south-

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Bringing you the best in scientific thought and opinion in exploration, research, and the world of nature

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December. 1955 Volume LXIV, No. 10

Climbing Screwpine ... Cover Design
From a color transparency by Ralph D. Cornell

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Man's Oldest Date in America ... Mark R. Harrington 512
Dramatic discoveries have tripled earlier estimates of man's antiquity in the Western Hemisphere

The Unorthodox Sea Hare ... Joseph Bernstein 518
This shell-less mollusk can be either male, female, or both at the same time and is runner-up for the title of World's Greatest Egg-layer

Tree-Leaping Kangaroos ... John Sidney 522
Jumps of 50 feet are not unusual for these aerial acrobats, which eat, sleep, and play high above their earthbound cousins

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When an archeologist is called upon to double for Sherlock Holmes, he may have trouble convincing the local people he has caught the right culprit

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Vilhjalmur Stefansson and Olive Rathbun Wilson 528
Charlatans of old traded on the public's ignorance of human physiology, and even the Royal Society could not replace superstition with science

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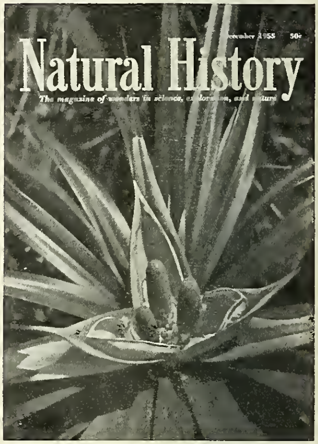

THE COVER THIS MONTH

The Climbing Screwpine shown here carries the botanical name of *Freycinetia arborea*. In its native Hawaii, the species is called *ieie*. There it grows in the forests at lower elevations, entwining its slender stems about the trees.

Ieie plants are either male or female. Strangely enough, the pollen is transferred from one to the other not by insects but by mammals—rats, which are attracted to the sweetish fleshy bracts.

Early Hawaiians used *ieie* for a number of things. The leafy branches served as decorations at *hula* dances. Fibers from the stems were used to bind together canoe outriggers and the rafters of native huts. The strong slender roots were woven into durable baskets and fish traps, and were used in the feather-covered helmets that chiefs wore into battle.

The genus *Freycinetia* ranges the South Pacific from Hawaii through Polynesia to New Zealand and Ceylon. It belongs to the *Pandanaceae*, or Screw Pine family.

Publication Office: American Museum of Natural History, Central Park West at Seventy-ninth Street, New York 24, New York

Please address all correspondence concerning Membership, change of address or missing issues to Circulation Manager,
American Museum of Natural History, Central Park West at 79th Street. New York 24, N. Y.

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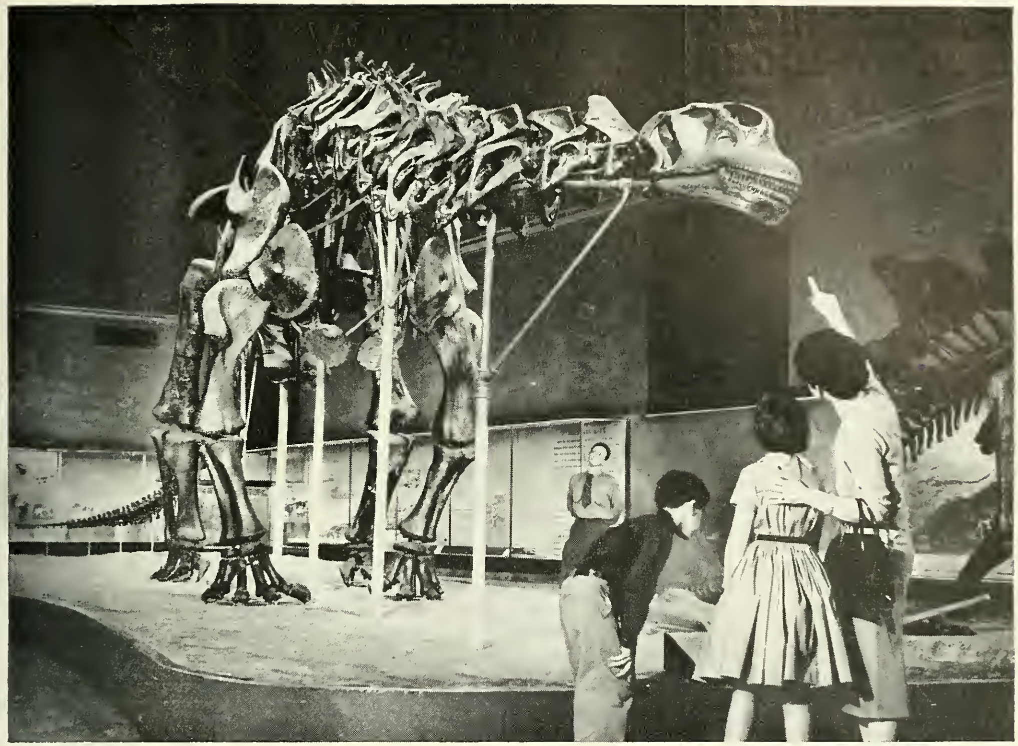

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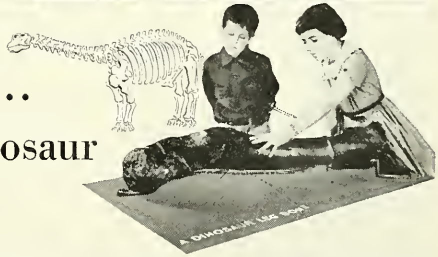

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HIGHWAY OF THE SUN

\- - - - - - by Victor W. von Hagen

Duell, Sloan and Pearce and
Little, Brown and Company, $6.00
4 maps, 32 pages of photographs, 320 pp.

THIS account of the Inca Highway Expedition will give the general reader a good picture of the extent and structure of the ancient highway system, an intriguing glimpse into prehistoric Peru, and some idea of life there today. It will give an equally clear picture of the trials and tribulations of life on such an expedition.

The main purpose of the two-year, six-member expedition, led by author Victor von Hagen, was to "rediscover" or rather to trace the main routes of the Inca highways. These roads, in part paved with stone, and marked every 12-16 miles by halting stations (*tampus*) for the runners (*chasquis*) are characterized by uniformity of width. One main highway extended 2,520 miles along the coast; the other stretched 3,250 miles along the Andes, often at heights of more than 15,000 feet. These highways were connected by lateral roads cutting across Peru's three geographic zones — coastal desert, highland, and jungle. The builders demonstrated skillful engineering where the road scaled the Andes and by such structures as the rope bridge over the Apurimac River gorge, famous as Thornton Wilder's Bridge of San Luis Rey.

The events of Mr. von Hagen's book follow the geography of Peru from south to north, focussing on the four principal roads connecting from the capital, Cuzco, to the four *suyus*, or divisions, of the Inca Empire. Although these roads were not followed to their conclusions by Mr. von Hagen, their general directions were noted. This involved correlating literary references to the Inca roads with maps and aerial photographs.

Archeological investigations were carried out at three main sites and their conclusions are given in summary. The ethnographic observations, although unsystematic, give a more rounded picture of the Road today. The maps are not as inclusive or detailed as one might expect in a geographical study. The book is a popularized personal diary more than an objective description of the results of the expedition and thus may be more interesting to most readers, though less accurate. Dinner menus, descriptions of *soroche*, or altitude sickness, news releases to the *New York Times*, and flashbacks to the events of the Conquest provide interesting, if occasionally confusing, reading.

Mr. von Hagen's style is descriptive, dramatic, and tends to lose itself in lyrical heights. However, this book should delight anyone interested in a vivid story of the prehistory and history of Peru.

ELLIN F. GROSSMAN

THE EDGE OF THE SEA

\- - - - - - - - - by Rachel Carson

Houghton Mifflin, $3.95
276 pp., 188 drawings

THE complex but interesting story of the animals and plants that live in the intertidal waters of the east coast of the United States has been well told by Rachel Carson in this, her third book. She has carefully blended an account of the environmental factors of the rocky, sandy, and coral coasts with the facts about the plants and creatures that struggle to gain a livelihood at the inhospitable edge of the sea. Throughout the book there is a constant reminder of the power of the timeless sea and the miraculous pattern of adaptation and co-existence among the myriads of forms of life.

The book is organized somewhat like an ecology textbook, but because it is sprinkled with personal observations and numerous drawings of living plants and animals, it will serve well those who are interested in marine life. About 200 different creatures march across the pages and display their forms, colors, actions, and reproductive methods. Any tidepool or beachcombing enthusiast who reads this book will be able to recognize and understand many of the objects he encounters on our beaches. For the even more seriously interested, there is an excellent appendix on the classification of the algae and invertebrates.

The explaining of this intricate community of the tidal world would not have succeeded without the 188 masterly drawings by the well-known naturalist-artist Bob Hines. Nearly every page in the book carries a beautiful and accurate pencil sketch of some living marine creature. For instance, in the story of the mangrove world, the reader need only glance to the upper half of the page to see, in life-like diorama, the fiddler crabs at work among the tree roots and oysters.

The Edge of the Sea will have great popularity among students and amateur marine biologists, but its mass of highly organized, though scientifically accurate, details will probably prevent it from becoming a very widely read book.

R. TUCKER ABBOTT

LIVING MAMMALS OF THE WORLD

- - - - - - - by Ivan T. Sanderson

Hanover House, $9.95
303 pp., 330 illus.
(190 in full color)

BECAUSE of the recent interest publishers have shown in promoting books on natural history, mammals have become many-pictured things. Man's interest in mammals has carried over from ancient forebears, who showed a preference for these animals when early art galleries were set up in caves. Now modern photography makes available a host of pictures in both black and white and in full color, and it is an obvious conclusion that a very good way to introduce mammals to the public is through the medium of a book of pictures around which a text is written.

This present volume is a portrait gallery of mammals, including the large spectacular ones, which are easily photographed, and as many of the obscure and seldom-pictured species as an extensive search has discovered. For the most part, these pictures show the animal at rest, posing for a portrait, and many are of animals in captivity. Their principal value is for the purpose of identification, and only a few were selected for action or unusual activity. The most immediate impact upon the reader is through the pictures, and these are adequately captioned.

But Sanderson has written a sound and interesting text. He takes the mammals up in the current systematic pattern, and provides a good index through which one can locate a particular mammal quite easily. He has a very good background for preparing such a text, through field experience and from familiarity with many of his subjects as pets or zoo inmates. Furthermore, he has a light and humorous approach to what might become a monotonous catalogue and turns up some unexpected and surprising side-lights.

While one has the impression that the color plates in this book are exceptional, a critical inspection reveals that a few overemphasize certain colors and are vulnerable to criticism.

HAROLD E. ANTHONY

THE BERMUDA GARDEN

- - Edited by Christine M. Whitney

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Bermuda
231 pp.

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Bermuda has no great annual range in temperature or in day length. Climatically, it can grow a wide variety of plants derived from the tropics and subtropics around the world. The thin soil and limestone base impose a limit upon this variety.

This book tells of the conditions on the island, lays a basis for taking up the plants systematically, and then describes the most important trees, shrubs, vines, perennials, annuals, etc. Twelve beautiful color plates, a half-tone, line drawings, and diagrams assist in following the text. Plants are in flower every month in the year, but the spring and summer put on the best show. Not only are beautiful gardens to be seen on private estates and in public parks, but roadsides and open fields catch the eye as well.

Not the least interesting part of this book is the list of common names, some of local origin. What could be more amusing than Scotchman's purse for the Malvaviscus, which never opens its flowers more than half way.

This book is highly recommended to anyone who wants to get the most from a visit to Bermuda.

Harold E. Anthony

THE NATURAL HISTORY OF NORTH AMERICAN AMPHIBIANS AND REPTILES

- - - - - - - - by James A. Oliver

D. Van Nostrand Co., Inc., $6.95
359 pp., 12 plates, 74 figures

MANY books dealing with natural history are merely compilations of facts. Others attempt to reveal "odd secrets or weird lore," striving to attract the reader with the sensational or the lurid. Still others, on a higher plane, attempt to assemble widely scattered information and to review it in a coherent fashion. This account of the salamanders, frogs, turtles, crocodilians, lizards, and snakes of North America falls in the latter category.

With an intelligent use of tables, diagrams, charts, drawings, and photographs, Dr. Oliver has been eminently successful in recounting much of what we know about the amphibians and reptiles on a continent where, in recent years, several hundred workers have been busily prying into the lives of these animals. True, we now have the species pretty well named and pigeonholed. Much remains to be learned about habits, behavior, and ecology, but already an impressive body of information is in print. Unfortunately much of this information is buried in obscure journals, and much of it is lacking in significance until it is reviewed as part of a broader picture. The task of assembling the pieces is only the beginning; fitting them in where they belong, especially when some of them are missing, requires considerable thought as well as background. Dr. Oliver has come forward with both.

The result of his efforts is a thoroughly readable account, covering innumerable topics from folklore to ecology. The style is simple but effective, with technical terms defined in a glossary. While evidently written for the layman, it might serve equally well as an introduction to herpetology in a college course. It supplements the numerous excellent handbooks that are now available for identification. But over and above that, it integrates much of the information contained in the handbooks. In other words, it fills a genuine need, and does it well.

Charles M. Bogert

GENETICS IS EASY

- - - - - - - - - - by Philip Goldstein

Lantern Press, $4.00
238 pp.

GENETICISTS like Nobel Prize Winner H. J. Muller warn that radiations, which are being produced in ever greater amounts by military, medical, and industrial practices, may severely erode the hereditary constitution of mankind. The small, subtle, but nevertheless injurious change or mutation produced by radiation is not obvious to the people of the present generation, but its effect will appear in the children of future generations and persists on the average for 40 generations.

What is the basis for this dire prediction? And what is the alternate, for there is a hopeful one? The answer lies within the scope of the subject matter of genetics, the science of heredity and variation. Everyone should have some knowledge of this important science in order that he may consider seriously and evaluate objectively the warning now being sounded.

In his book, Philip Goldstein has presented the basic facts and theories concerning heredity and variation. While this reviewer may not approve of the author's overoptimistic title *Genetics Is*

Easy, he will admit that the author has presented the introductory material of genetics as simply and as graphically as possible. Beginning with the description and explanation of the pioneering experiments of Mendel and his predecessors, the author by carefully-designed and well-tested diagrams explains the more complicated types of inheritance. The author tells the reader how to solve the problems, which are presented to the geneticist. This takes up about the first half of the book, and this part constituted most of the material in the author's first edition of the book. The present second edition adds more information about the new concepts in heredity. This second half is not as successful as the first, because the subject matter is far more difficult than may be explained in the few short paragraphs that are devoted to each topic. Sometimes the statements are so generalized as to be meaningless, but perhaps they are made to arouse the reader's interest to such a pitch that he will be induced to seek further information elsewhere.

The author's style is simple and clear, but sometimes his efforts result in writing too far down to the reader, as if he were fitting his words to the needs of a first-year high school student. Despite these annoying lapses, the book will give the reader the basic facts of genetics, providing he is prepared to study hard.

Myron Gordon

DOCTOR JIMEK I PRESUME

- - - - - by Dr. Bernhard Grzimek

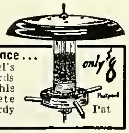
Thames and Hudson,
224 High Holborn
London, W. C. 1, 16 shillings
224 pp., 22 illus.

IN THIS absorbing but somewhat rambling narrative of an eventful journey to the Ivory Coast, Dr. Bernhard Grzimek, Director of the Frankfurt Zoo, gives his readers a rather alarming picture of the rapid rate at which wildlife is being devastated in Africa.

The Nimba Sanctuary, it seems, is the only wildlife reserve in the whole of Africa in which not only is shooting prohibited but neither black nor white is so much as allowed to set foot.

The principal object of Dr. Grzimek's trip was to study the habits of East African animals in their natural surroundings. His various adventures with elephants, hippopotami, chimpanzees, and other creatures are described in detail and often with rare humor. He carried no guns, and though this was strictly an observation trip, the doctor took back with him live chimpanzees, which the natives were willing to give up because they were getting too large to handle with safety. Anyone who has spent time in the African bush will readily realize that Dr. Grzimek stays strictly with actual facts as they happened without glorifying his sometimes pleasant but more often gruelling experiences. This is an entertaining book translated from the German edition and should please almost everyone.

George G. Goodwin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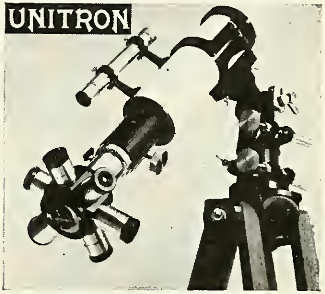

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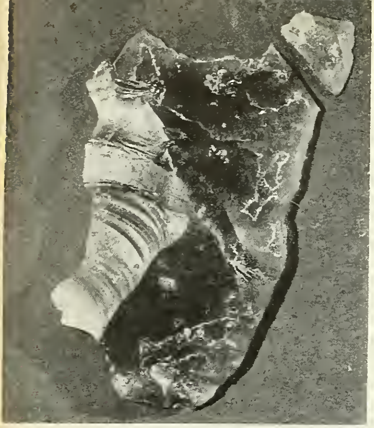


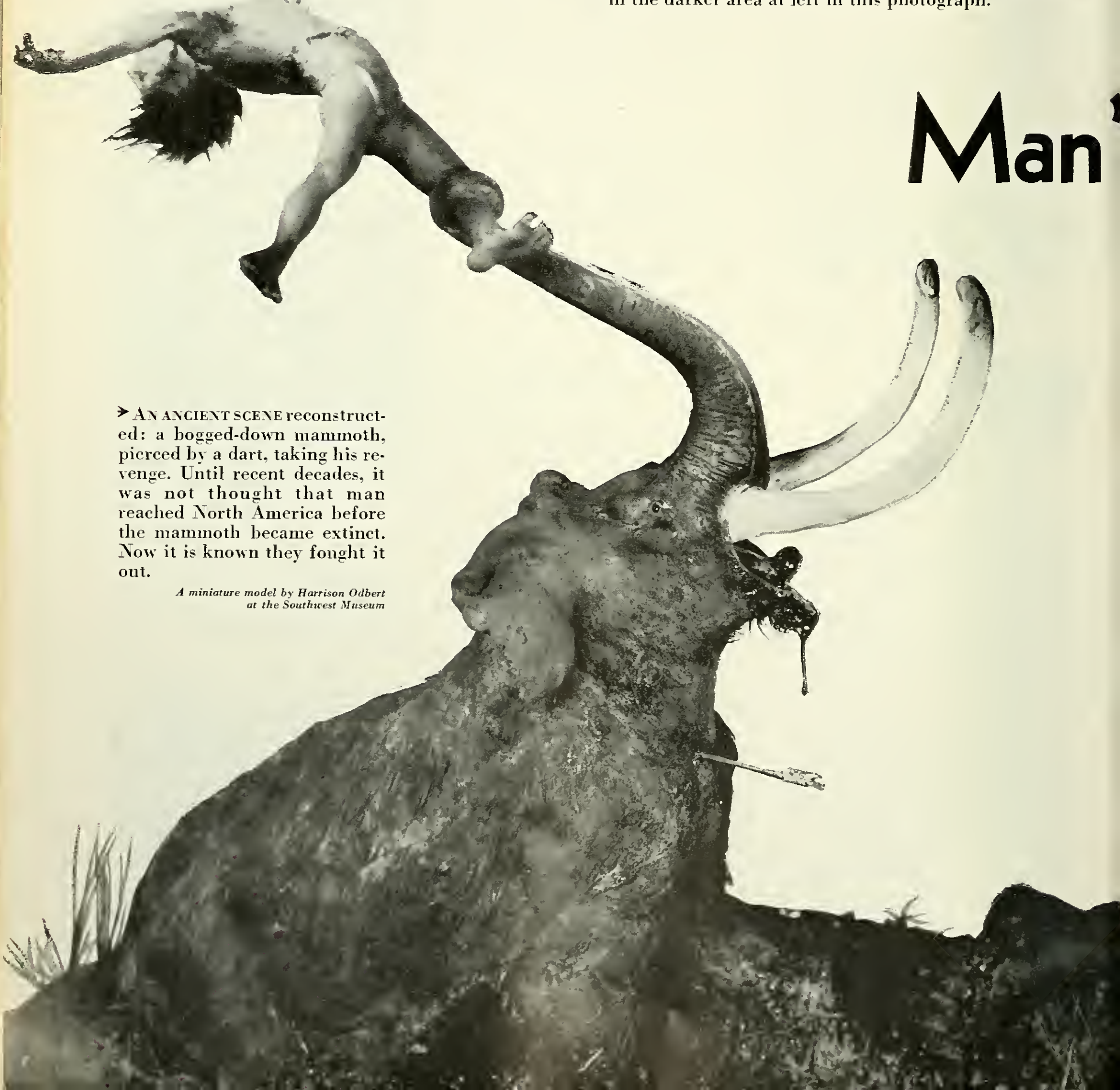
AMNH

◄ THE FLAKE OF OBSIDIAN that revolutionized scientific thought. It was struck off by a man who dined on prehistoric animals ten miles north of Las Vegas, Nev. The Carbon 14 test says he built a campfire more than 23,800 years ago.

Southwest Museum

▲ THE HISTORIC OBSIDIAN FLAKE and charcoal were found in the darker area at left in this photograph.

Man



➤ AN ANCIENT SCENE reconstructed: a bogged-down mammoth, pierced by a dart, taking his revenge. Until recent decades, it was not thought that man reached North America before the mammoth became extinct. Now it is known they fought it out.

A miniature model by Harrison Odbert at the Southwest Museum

Simpson and Peck

▲ LOCALE of the discoveries: the ancient lake deposits and mountains as seen from the Tule Springs site.

Oldest Date in America

Dramatic discoveries have tripled earlier estimates of man's antiquity in the Western Hemisphere

By MARK R. HARRINGTON
Curator, The Southwest Museum
Los Angeles, California.

"I am not speaking for publication!" the late Dr. Ales Hrdlicka warned me with upraised finger. "But in my opinion, evidence is accumulating that man has been in America at least 10,000 years!"

That was in 1937, and the reason he did not want this opinion published was because it was a new one for him. All through his long career for the Smithsonian Institution he had always maintained that man had been in America for only 3000 or 4000 years at the most. And he had discounted all discoveries that had conflicted with this dogma.

How surprised he would have been had he known that, at that very time both the Southwest Museum and the American Museum of Natural History had in their possession evidence that would eventually indicate that man had been in America "more than 23,800 years"! I would have been surprised myself. The evidence was charcoal discovered at the Tule Springs site in southern Nevada by Fenley Hunter and Albert C. Silberling. It was later tested for age by the Carbon 14 method by Dr. W. F. Libby of Chicago University, who is now with the Atomic Energy Commission.

And little did Fenley Hunter and his companion think when they started, away back in 1932, to search the Vegas Wash for bones of extinct Pleistocene animals, that they would find with them traces of man. Certainly they never dreamed that their discovery would eventually more than double the known age of man in America!

Mr. Hunter had financed and was leading the expedition for the American Museum of Natural History. His companion, Mr. Silberling, had enjoyed long experience in work of this kind. So they were well prepared.

They found little in the upper end of the Wash, around Indian Springs and Corn Creek, but when they reached the areas some miles below Tule Springs, their luck began to change.

Here the floor of the valley was composed of a water-laid deposit more than 20 feet thick and containing many small shells. Through this, the Wash had cut a broad channel, with numerous side canyons, along the base of a long range of mountains. They began to find bones and more bones lying on the original hard clay floor of the valley, where erosion had carried away the deposits under which they had been buried.

They set up camp in this new area and their finds continued. They found bones of Camelops (the largest American camel), two skulls of a huge long-horned bison of the Ice Age, part of the skull of a ground

Peck

▲ THE CAMP of this year's expedition near Tule Springs.

▼ THE AUTHOR, pointing to the original valley floor on which the evidences of man have been found. In the background are thick lake deposits, laid down subsequently and not yet eroded away.

Simpson

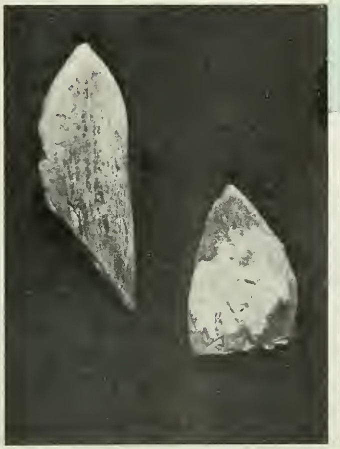
sloth, and a portion of the skeleton of a mammoth—an American elephant. Then, in a side canyon, they made their great find.

At first it did not seem to be especially important, merely a layer of broken bones resting on the hard clay beneath the water-laid deposit. But when the two men started digging, they were surprised to see ashes and bits of charcoal among the split and broken bones of various kinds of Ice Age animals. And then they encountered an unmistakable man-made flake of obsidian!

Great credit is due to these men, because instead of pulling out the flake for examination as many of us might have done, they cut out a block of the ash-bed matrix, leaving the flake still embedded among the bones. They packed it carefully and transported it undisturbed to the American Museum of Natural History.

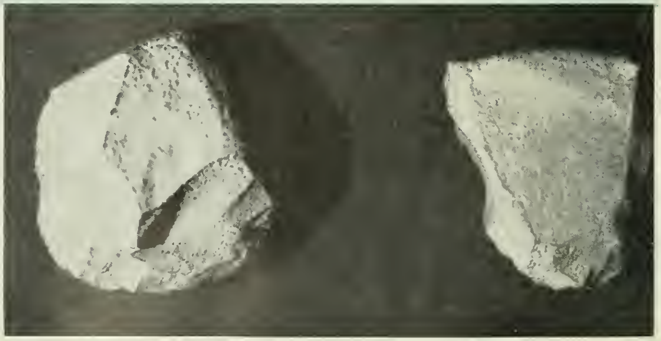
Here the flake was removed from the matrix by the well-known paleontologist, Dr. George Gaylord Simpson, in the presence of Mr. Hunter and the archeologists Nels C. Nelson and Junius Bird.

The flake showed a "bulb of percussion" where it had been struck off from the original obsidian block by human hands. It was what might be called an interior flake, one that does not retain any of the outer surface of the obsidian nodule or pebble from which it was obtained. At least three other flakes had been removed before this one. Although it did not show positive evidence of retouching on the edges or of use,



FROM NORTH AMERICA'S oldest campground. Left: tools of split bone shaped by grinding. Below: a chipped stone chopper or hand ax, and a scraper. (About half actual size.)

Southwest Museum



it could well have served as a knife. It even had one of the bone fragments adhering to it.

Being found some distance back in the deposit, there was no chance that it could have been slipped in recently. Moreover, no obsidian exists naturally in the vicinity, nor are there any traces of obsidian-using Indians in the neighborhood; so there is little chance that it could have worked down in more recent times through an animal or root hole.

Dr. Simpson published the find under the title "A Nevada Fauna of Pleistocene Type and Its Probable Association with man."[1] The date of publication was October 23, 1933.

Simpson

▲ **Stuart L. Peck**, mapping the terrain at the Tule Springs site.

The Broadening Perspective

Today, this evidence is taken as proof that man lived in western North America at a time when animals of the Ice Age still survived. But in an era when many scientists like Dr. Hrdlicka still believed that man could only have been in America a few thousand years, Dr. Simpson preferred to say "Pleistocene Type" instead of "Pleistocene" and "probable" instead of "evident."

To many in that day, any find indicating an older age was looked upon as a possible fake, a mistake, or an indication that Pleistocene animals had survived until recent times in America. Some even suggested that the charcoal from the Tule Springs site, instead of showing the presence of man, must have resulted from a forest fire caused by lightning.

Present-day archeologists (or most of them) would realize that no agency other than man could have broken and split the bones of various animals and mingled them in one small deposit of ashes and charcoal. Certainly a forest fire, though it might produce charcoal, could not do this. On top of it, there was the man-made flake.

There had been a number of previous indications that man had lived in association with the Ice Age animals. In the writer's Gypsum Cave report[2] are listed 23 finds of this kind that were made before the Tule Springs discovery, most of which now seem to be authentic. One of the earliest was a mastodon skeleton found in Gasconade County, Missouri, by a Dr. A. K. Koch. The bones were much burned and covered with ashes and charcoal, and a number of stone implements, including points, were found in association with them. This was as long ago as 1839, and the following year Dr. Koch found another mastodon skeleton associated with two stone points, which he called "arrowheads." One of them was under and actually touching one of the animal's leg bones. Next, in 1846, came the discovery by a Dr. M. W. Dickeson of part of a human pelvis associated with the bones of two species of ground sloths in a peat deposit near Natchez, Mississippi. Then there was W. J. McGee's obsidian spearhead, found with elephant bones in Walker Canyon, Nevada. About the same time (1885) Prof. F. W. Putnam reported the finding of a mastodon tooth with a human skull, in a swamp deposit eighteen feet below the surface, near Worcester, Mass.

Incidentally, Prof. Putnam must have been severely criticized when he published this find in *Science* under the title "Man and the Mastodon," because many years later, when I joined the staff of the American Museum, he advised me: "If ever you make a find that seems unusually old, just report it—don't attempt to interpret it, or you will get into trouble!"

There were various other discoveries, involving extinct horses, camels, and bison, as well as ground sloths and elephants. But the event that really started the change in scientific thought on the age of man in America was the discovery, in 1927, of a group of skeletons of an extinct species of bison, near Folsom, New Mexico.[3] Among their bones were embedded a number of unusual fluted dart points (small spearheads). These were viewed in place by respected scientists and did more than anything else to break down the idea that man was a newcomer in this hemisphere.

A similar find with the same "Folsom type" fluted points was later dated by Carbon 14 at 9883 years old, with a possible error of 350 years either way—an age that would have been considered excessive in 1932 but is dwarfed by what we have learned since.

The Southwest Museum's work of

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[1] American Museum *Novitates* No. 667.

[2] "Gypsum Cave, Nevada," by Mark Raymond Harrington, *Southwest Museum Papers*, No. 8, Los Angeles (1933).

[3] See "The First Americans," by C. Bertrand Schultz, in Natural History Magazine, Dec. 1938.

1930 and 1931 in Gypsum Cave, Nevada, only a short distance east of Tule Springs, also helped to turn the tide of opinion. This yielded ground sloth, camel, and horse remains in association with various signs of man. On geological and archeological grounds, we estimated the age roughly at 10,500 years. This was later confirmed by Carbon 14, which gave 8,527 years for one, sample and 10,455 for another from a deeper zone.

After our Gypsum Cave experience, we were naturally delighted when Mr. Fenley Hunter turned his Tule Springs site over to the Southwest Museum and gave us the opportunity to examine the spot where such an interesting discovery had been made. So in 1933, the writer and his long-time friend and assistant, Mr. Fay Perkins, spent some weeks at this fascinating but windy place.

We found this part of the Vegas Valley to be a gravelly desert, dotted with small bushes, and with mesquites, apparently dying of drought, in some of the hollows. Reaching the banks of the Vegas Wash, we noted that the gravel surface layer was very thin and that the main wash and many of the side canyons had cut down into the underlying clay beneath the deep silt layer. Examining the latter carefully and the small shells it yielded, we were convinced that we had before us a deposit that had been left by a lake or pond, not a stream. Many of the side canyons had not cut down into the underlying clay, and some areas, acres in extent, had lost their gravel coating and were partly eroded. The reflection of the sun on these almost white deposits was really dazzling.

We made camp in a slight hollow to escape the fury of the wind, but even here our tent was nearly blown down several times before we left. Mr. Hunter later told me that their experience had been similar.

Starting out at the Hunter campground, we were soon able to locate the place of his discovery; but as we had expected, the ash-bed had been completely dug out. Nothing remained but a little terrace on the wall of the side canyon, but we regarded it with a feeling of awe, especially when we noted the crumbs of bone and flecks of charcoal in the Hunter "back-dirt." I think if I had been wearing a hat, I would have taken it off.

As we walked back up the main wash, we wondered how we could locate other deposits of that type if any still remained. Then we turned into another side canyon leading toward camp. Suddenly Fay whispered, "Do you see what I see?"

I looked, and there were scraps of bone at the bottom of the embankment on our right. At first, we could not see where they came from, but a little digging in the silt washed down from above revealed what we were looking for. On the top of the clay and under the lake deposit lay our first ash-bed! It contained a mammoth tooth and numerous split and broken bones of other animals, in addition to ashes and charcoal.

From that time on, it was one ash-bed after another. We had all we could handle during the brief period our funds allowed. A few had been real ash dumps, natural hollows into which camp refuse had been thrown. We found any amount of the split and broken bones of extinct animals, some of them burned,

Simpson

▲ THE DISMEMBERED MAMMOTH was discovered here by Ruth D. Simpson. Part of the decayed tusk is seen protruding in the foreground.

➤ PORTIONS of the dismembered mammoth exposed after careful excavation.

Peck

from elephants down, but mostly camels. And we were fortunate enough to discover among them two awl-like bone implements and part of a third. Still more fortunate, we found several crude but distinctly chipped stone implements, not directly in the ash-beds, but near by and on the same level. One was clearly a "chopper" or hand-ax, worked on both sides. Another was a large scraper or chopper worked on one side only. There were a few other large chipped objects of undetermined use, perhaps unfinished. But we found no projectile points of any kind, or even fragments of them.

Nowhere did we find any bones lying in their natural relationships, except the bones of one camel's foot, which had apparently been hacked off and thrown into the ash dump.

We saved a quantity of the ashes and charcoal in the hope of some day having the plant species identified, and this material, upon the writer's return to the Museum, was placed in storage.

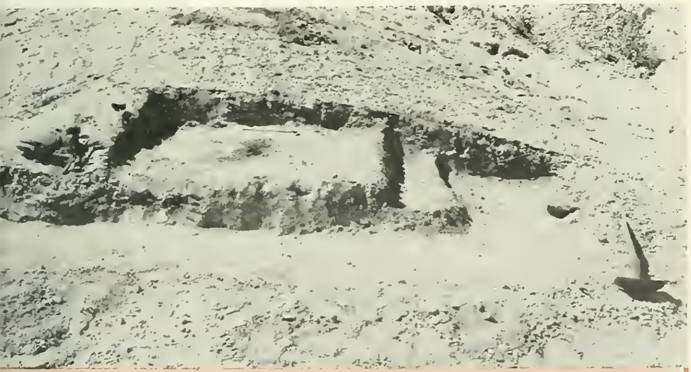
Years later, after Carbon 14 came into being, we thought of having the Tule Springs charcoal tested for age by the new method. But through a reorganization of our archeological storage, it had been mislaid. It was not until the spring of 1954 that one of our enterprising volunteer workers, Mrs. Freddie Curtis, while assisting our Assistant Curator, found it in a locked closet. We lost no time in sending a good sample to Dr. W. F. Libby of the University of Chicago. A little later, he asked for a second sample, which was mailed to him. Meanwhile, Mr. Hunter contributed another lot from the original find, which had been stored at the American Museum.

A Startling Announcement

We were quite overcome when we received Dr. Libby's final report. The charcoal had lost all its radioactivity and must therefore be "more than 23,800 years old!"

With renewed interest, another expedition was sent to Tule Springs last May to look over the possibilities of extensive work. The party, besides the writer, consisted of Miss Ruth D. Simpson, Assistant Curator of the Southwest Museum, and Charles Rozaire of the Universisty of California at Los Angeles. Stuart L. Peck of the Archeological Survey of Southern California joined us, bringing his jeep; and S. M. Wheeler of the Bowers Memorial Museum at Santa Ana, accompanied by his wife, came with his station wagon. Naturally we were equipped with Government and State permits.

We had learned earlier that all our old roads of entry to the site had been cut off, on one side by a very exclusive lady ranch-owner and on the other by a government air base. However, Mr. Wheeler and Mr. Harlan Brown, an engineer friend of his from Las Vegas, had searched out a new route. This was very soft in some spots and rough in others, but we finally made it and set up our tents (in a rainstorm) not far from Mr. Hunter's original campground. We were plagued by additional rain, several days of extreme heat, and frequent high winds, but we were able to accomplish a number of things in spite of these handicaps. Incidentally, two of our tents actually did blow down this time.



Simpson

▲ Where prehistoric man feasted on Ice Age animals near the present city of Las Vegas: a circular firepit containing charcoal, partially excavated.

First of all, we relocated the original Hunter "dig," and with the aid of photographs from the Southwest Museum's 1933 expedition, found all of its excavations as well. Then we started to look for more ash-beds. We found a number, the most unusual of which was a pit where one or more camels had been cooked and eaten. Finally, we made a reconnaissance of the whole area and mapped and photographed the most important section.

It was during the reconnaissance that Miss Simpson spied some bone fragments from the jeep as she rode along the bed of the main wash. Following these up on foot, she traced them back to a side canyon and came upon a large part of a mammoth's skeleton, including a tusk more than seven feet long! An interesting feature was the fact that near the skull (which was in bad condition) and on the same level, was a small bed of charcoal, probably the remains of a fire kindled by human hands in the dim era whose secrets we were trying to fathom.

For some reason, the bones of this great skeleton were somewhat separated, although none were artificially broken or split. This find was some distance from the large ash-bed area—the main campsite of the ancient people.

We collected much more charcoal for additional Carbon 14 tests, but this cannot be submitted for some time as it has probably been contaminated by the fallout from the atomic blasts set off in the Las

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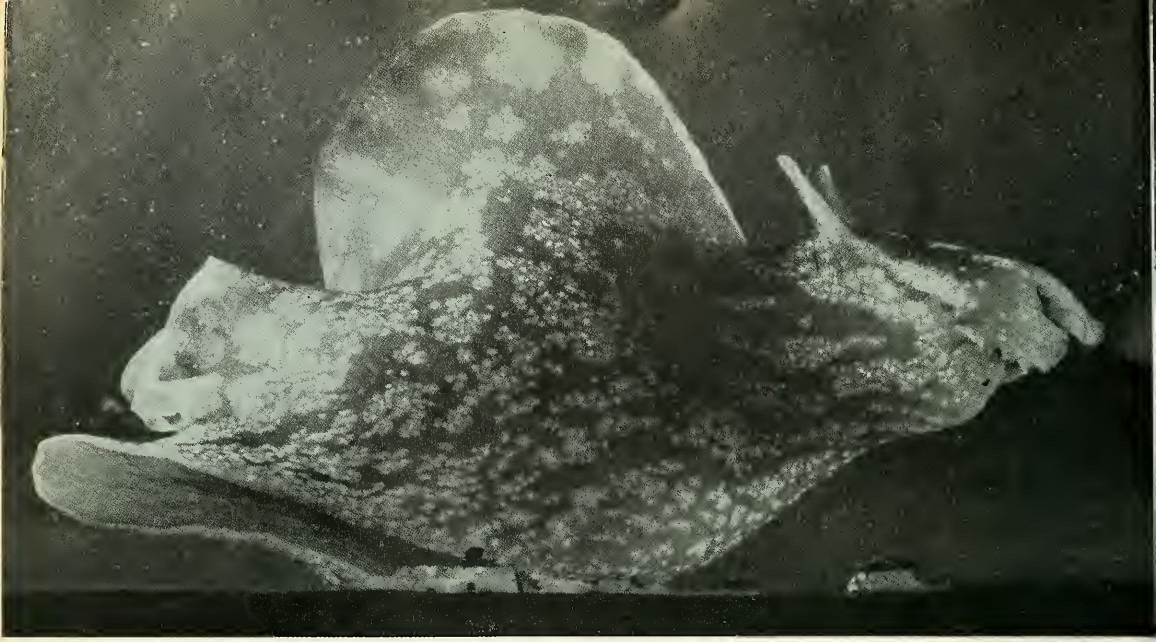


Willis T. Hammond

▲ THE SEA HARE gets its name from the slender rabbitlike "ears." This side view also shows the fleshy, winglike extensions of the mantle with which it "flies" through the water.

The Unorthodox Sea Hare

This shell-less mollusk can be either male, female, or both at the same time and is runner-up for the title of World's Greatest Egg-layer

By JOSEPH BERNSTEIN
Formerly of the *Division of Oceanography, U. S. Navy Hydrographic Office*

IMAGINE a snail that looks something like a rabbit and "flies" through the water like a bird,—and you have Tethys, the sea hare. Watch it flapping its wings as it swims, and you will have difficulty dispelling the illusion that it is a bird. Examine its two tentacles, so startlingly like the ears of a rabbit, and you will see how it came to get its picturesque name.

Other creatures of the sea swim with similar flapping movements of their "wings." Mantas and rays are good examples. But these are fishes, whereas the sea hare is a mollusk, a relative of the clams and cuttlefishes.

Sea hares are naked snails. They have abandoned their shells but bear traces of their ancestral houses in the form of much reduced internal shells, thin and transparent. They are thus relicts of an ancient evolutionary process—links between snails with complete shells on their backs, and the sea slugs, which have discarded them entirely.

One may speculate why this branch of snails found it advantageous to rid themselves of their shells. Perhaps their inedible flesh made protective armor unnecessary.

Sea hares belong to a group of mollusks known as the tectibranchs (pronounced *tek*-ti-brangks). This means, literally, that they have covered gills. The nudibranch snails, to which the sea slugs belong, really live dangerously. Having cast off their armor once and for all, they also recklessly expose their delicate gills to the outside world, without any protective cover.

When the sea hare moves its wings (which are actually extensions of its fleshy mantle), it causes water to circulate over its gills. This is necessary to supply it with oxygen, because the sea hare's gills are not openly exposed to the water.

The favorite food is seaweed, and

the sea hare will browse contentedly on such fare with no desire to change its diet. If the cow munching on grass is the classic example of a land animal's placidity, the sea hare nibbling on seaweed is a classic picture of bliss among the creatures of the sea.

Unlike most of the other animals of similar taste, which take a furtive bite of seaweed here or there, the sea hare really settles down to the job. While dining, it remains heedless of the comings and goings of awesome creatures that would send other less fortunate animals into frenzied efforts to escape.

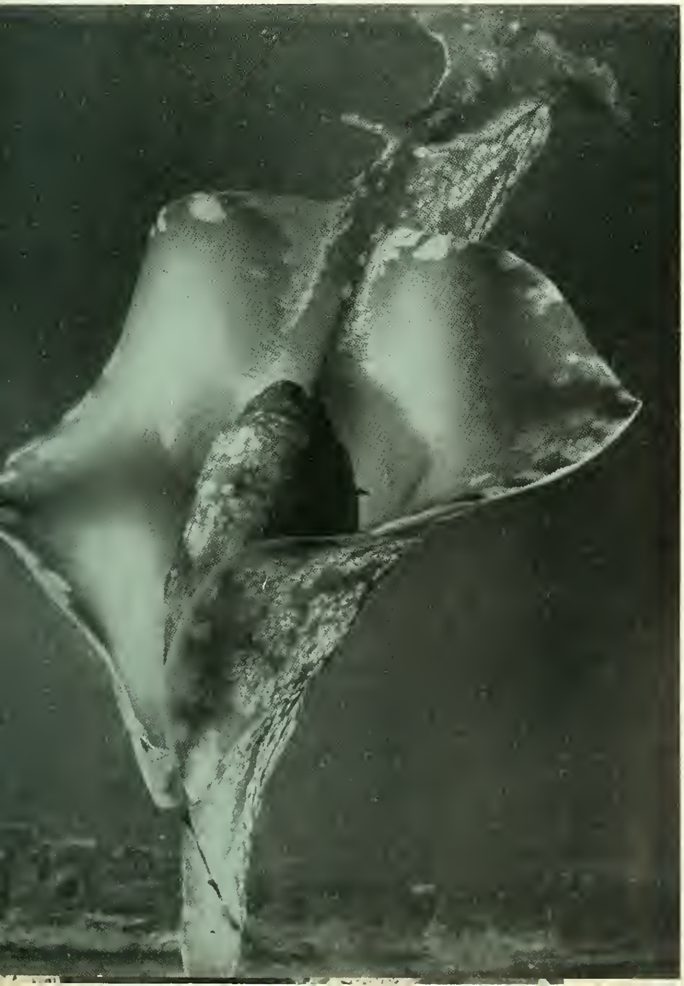
Suppose an intruder succeeds in disturbing its serenity. Then Tethys, the sea hare, will at last respond—by ejecting a vividly purple cloud. This is secreted by tiny glands in its mantle cavity. Under the protection of this smoke screen, it will leisurely hie itself off to other pastures.

In addition to its "flying," the sea hare also crawls on its foot. Indeed, the latter method of locomotion is more common.

If the intruder is rash enough to take a bite out of this seemingly toothsome and fleshy creature, the experiment will invariably be repented. The foolhardy biter quickly ejects its bitter mouthful, with every sign of distaste, and beats a hasty retreat. There is a good chance that it will never molest another sea hare as long as it lives—or as long as the experience leaves its imprint on its psychology.

▼ **THE DARK ELLIPTICAL MASS** in the center of the sea hare visible in this back or top view contains the internal organs, as well as what is left of its shell.

Willis T. Hammond



The purple dye released by Tethys is not at all poisonous, and should you dip your handkerchief into it, the cloth will take up the brilliant color. However, water will rinse it out again. This dye was not the one that gave rise to the expression "royal purple" among the ancient Romans. That was produced by a certain snail with a well-developed external shell and no device for ejecting its dye. It is not known whether these two kinds of dye are similar. The answer might prove interesting, in that it would cast light on the evolution of the sea hares.

The release of a protective cloud is a favorite device of other types of mollusks, the octopus and squid for example. But their dye is inky black, not purple.

Tethys tears or rasps off pieces of seaweed with its muscular lips, in conjunction with an unusual rasp-like structure called the radula. This is present in all snails and serves as a conveyor belt, transporting the chunk of seaweed down the digestive tract. The food first passes into two dilated pouches, the crops, which are lined with horny plates. There an extensive and thorough mastication takes place, and the macerated food is finally digested in the stomach. Other sea animals feed on seaweed, but few can boast such a complicated digestive apparatus.

The sea hare does not compete with other denizens of the ocean in brilliant coloration. In fact, it has gone to the other extreme and adopted an almost nondescript appearance. We have previously mentioned the two tentacles that stick back like the ears of a rabbit. These are the upper pair. Another pair of tentacles bear simple eyes and are also used for smelling the environment.

The specimen shown in the photographs was brown, with lighter patches of tan. Other species may be olive-green or olive-brown, with darker blotches. For an animal feeding on seaweed, such a color pattern serves as excellent camouflage.

By contrast, some of the sea slugs —close relatives of the sea hare—are possibly the most gorgeously colored creatures of the sea. But it is unlikely that such a dazzling color display exists for the esthetic edification of other animals. More likely, the magnificent hues and brilliant pattern have a practical and grim function. They are a warning to ravenous prowlers to stay clear. Experiments made with hungry, carnivorous fishes amply demonstrate the effectiveness of this warning display. Would-be diners give the sea slugs a clear berth.

A sea hare gliding through the water with graceful flapping of its wings has a certain attractiveness. But once removed from its watery habitat, its elegance vanishes as if by an evil spell. It collapses into a shapeless, ugly mass—a most repulsive sight to behold.

Sea hares reach a healthy weight and size for snails. Most attain seven or eight pounds in a single year, and two-year-olds even achieve sixteen pounds. Mature individuals are a foot long, which was the size of the Atlantic coast specimen shown in the photographs. The rate of growth required to reach such a size in so short a time is truly remarkable and has inspired awed comments from experts. The sea hare easily outstrips most of the other creatures of the sea in this respect. But what makes the feat unusual is that it is accomplished under far from ideal conditions.

The usual way for sea animals to fatten up is to settle down in a good spot and let the currents bring an endless supply of floating nutriment. But the sea hare must move around and find its food. Only when it has found choice pastures can it take things easy, relying on its protective coloration and distasteful flesh. It may then feed as gluttonously as it wants. That is why it can grow so luxuriantly. Other animals could do the same if they were assured of an endless feast without being molested by their enemies.

Tethys is a true cosmopolitan and is represented by 50 species. It thrives in a variety of environments but seems most contented with the area between high and low tides on rocky or muddy shores. Generally it prefers warmer water. The specimen shown here, however, was captured in a lobster trap in Cape Cod, Massachusetts — an area not noted for its warm water. Cape Cod is not often frequented by sea hares, and this individual may have migrated northward in warmer waters along the Atlantic coast. Since other warm-water animals have in recent years been found at Cape Cod, this carries the hint that the climate on the east coast of the United States may be getting warmer, which indeed is indicated by other evidence as well.

Sea hares do not fare too well in captivity, possibly because they are finicky about temperature. The creature trapped in Cape Cod was placed in a tank, but it did not live long. When the temperature of the water dropped to 50 degrees F., it died.

Dual Sexuality

Tethys is hermaphroditic; one individual possesses both male and female reproductive organs. This, of course, is not unique in the animal kingdom. But the sea hare responds to its dual sexuality in a most unorthodox, not to say whimsical, manner. According to its fancy, or perhaps by pure accident, it can act either as a male or female, or even both at the same time.

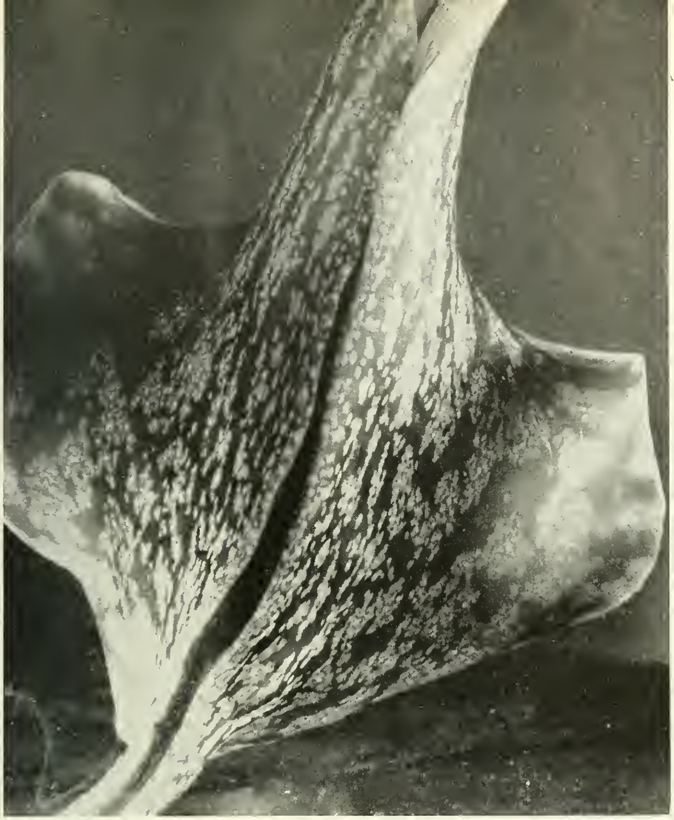
On occasion, groups of as many as eight sea hares have been seen mating in rows and even forming a complete circle. In such cases, each animal was playing the role of both male and female at the same time. Whether the sea hare suffers from a split personality or develops neuroses because of this is unknown.

We now come to an aspect of the sea hare's life that is truly spectacular—its phenomenal egg-laying. Tethys is one of the most fabulous egg producers in existence, and to describe it literally as an egg-laying machine would not be an exaggeration. The egg production of many other highly fertile creatures of the sea, even that of the much respected cod, is merely piddling by comparison.

When Tethys is ready to spawn, it moves inshore and there deposits large masses of eggs on the rocks or on seaweed. A single egg mass may be larger than both your fists together. The eggs are laid in bright yellow or salmon-colored strings. If you examine these ropy masses, you will notice that they are composed of capsules. There are four capsules to each spiral twist of the string.

The egg mass could well be mistaken for a ball of yellow yarn. Dr. G. E. MacGinitie, a marine biologist now at the California Institute of Technology, has estimated that there were about 86 million eggs in a single mass that he once inspected. He and his associates made an intensive study of the egg-laying of a sea hare weighing slightly less than six pounds. The eggs were counted by selecting several chunks of string, weighing them on a balance, and then counting the eggs. By weighing the entire mass, it was possible to estimate the total number of eggs. It was found that this particular sea hare laid about 478 million eggs in a period of slightly over 4 months. There were 27 layings in all, and the creature was able to lay 41,000 eggs a minute. Had the mass been stretched out in a single string, it would have reached a third of a mile! The eggs are extremely tiny, each being 77/1000 of a millimeter in diameter—about a third the size of the human ovum.

Now, there are other sea animals that can boast similar feats. Some species of oysters, for example, can release about a half billion eggs in a season. But this is not a fair comparison. The sea hare that was studied did not have a real chance to turn out a stellar performance, for it died two days after depositing the last batch. Laboratory conditions are not usually favorable for demonstrating what a sensitive creature's capacities might be in a state of nature. The captive sea hare



Willis T. Hammond

< Viewed from below, the sea hare reveals a long folded "foot," running the entire length of the body. It is used for attachment while feeding, as well as for moving along on an object. At top are seen the broad lower tentacles, at the ends of which are the eyes.

might well have done considerably better under natural conditions, perhaps exceeding the half-billion mark.

When one considers what a full-grown specimen of sixteen pounds could achieve, it is enough to stagger the imagination. It may well be that the astronomic number of eggs produced would be the world's record for the animal kingdom. As far as I have been able to find, however, the egg-laying of so heavy an individual has never yet been recorded.

The sea hare's egg-laying is far from a simple, effortless task. It is an exhausting, laborious ordeal, and perhaps it is no wonder that sea hares do not survive long after the job is finally done. When the eggs first emerge, the animal seizes them in a fold of upper lip and covers them with a gelatinous substance. Then, by moving its head back and forth, it attaches the egg string at varying intervals to the clumps of eggs previously deposited. This is what makes the egg mass look like a ball of twisted yarn.

With Tethys laying such fantastic numbers of eggs, it is clear that the chance of an egg developing into an adult must be exceedingly remote. Otherwise the entire planet would soon be engulfed with sea hares.

The animal kingdom offers instances of parental devotion to the young, but the behavior of the sea hare cannot be included among them. Once it deposits its eggs, it blandly leaves its young to their fate.

And this fate is often dire. First of all, the egg masses themselves may be devoured, particularly by starfish, though it takes a hungry starfish to be tempted by such an unappetizing repast. Then the larvae must hatch out close to where seaweed abounds. Too far offshore they would be doomed to starvation. Seaweed, you will recall, is the only thing sea hares eat.

Even if they hatch near seaweed, their troubles are far from over. Awaiting them are a vast array of creatures that will feast on them with enthusiasm — barnacles, sea anemones, hydroids, worms, bivalves, flatworms, crabs, and small fishes.

There is only one hope for such a larva. It must evade these hungry mouths and tentacles long enough to reach the size of about one-eighth of an inch. It then becomes distasteful as food. Most would-be enemies will thereafter leave it strictly alone.

If the success or failure of an organism be judged by its ability to establish itself in large numbers, the sea hare cannot be rated a howling success. But in one very important respect it has succeeded. It has been spared the attentions of that enterprising animal, *Homo sapiens,* who in spite of his ingenuity has yet to find any use for the sea hare.

> Egg mass of a Pacific Coast sea hare deposited on seaweed. A single such mass may be larger than two fists and is bright yellow or salmon-colored. The creature exhibits no concern for the eggs or the young.

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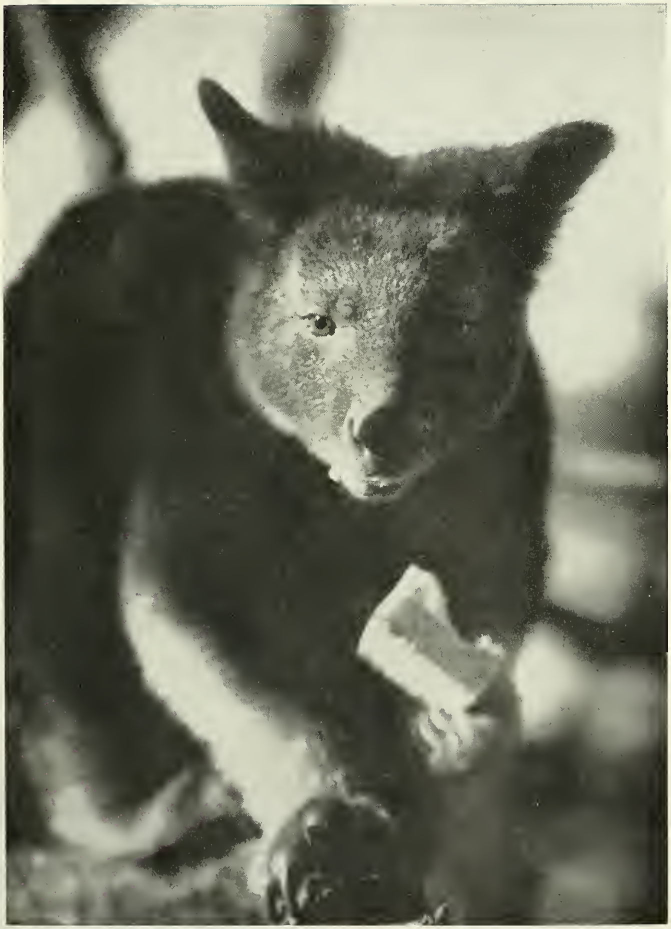
Tree-Leaping KANGAROOS

Jumps of 50 feet are not unusual for these aerial acrobats, which eat, sleep, and play high above their earthbound cousins

By JOHN SIDNEY



Australian News and Information Bureau

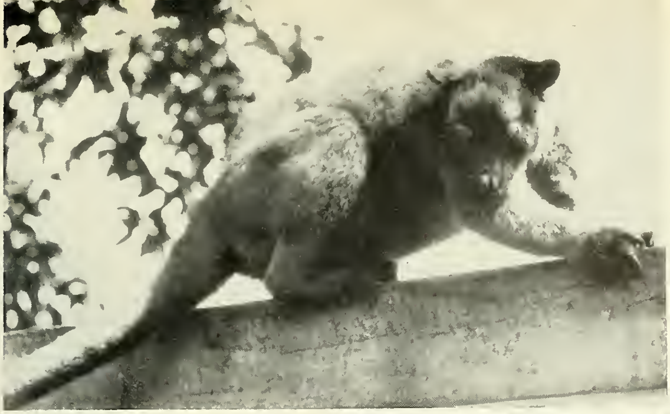
▲ TREE KANGAROOS *(Dendrolagus)* have large hands with long curved nails on the fourth and fifth toes, obviously useful in their treetop travels. These kangaroos are much smaller than the ordinary ones, and their fore and hind feet are more equally proportioned.

FEW people, including Australians, know that in northern tropical Queensland there are two species of kangaroos that can shin up trees and make great leaps of 50 feet to the ground. I was vaguely aware that some kangaroos could climb trees, but I knew nothing about the odd antics of these acrobats until I visited Cooktown, in northern Queensland.

Cooktown is on the coast near the 15th parallel, about 600 miles north of the Tropic of Capricorn. This is rain forest country with giant cedars (*Cedrela australis*) and eucalypts soaring over the tangled green tropical undergrowth of lianas and big ferns.

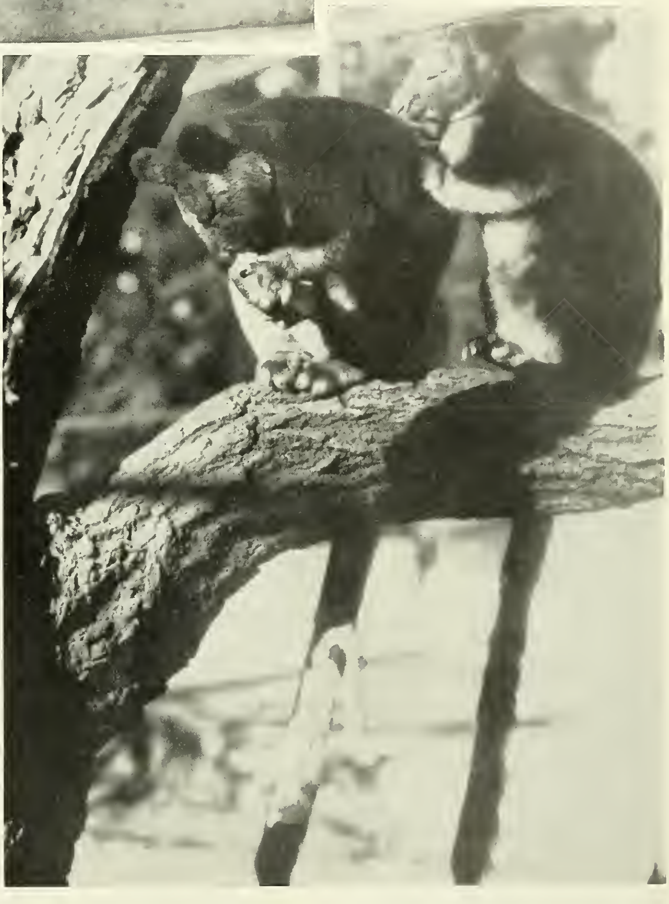
I saw my first tree kangaroo in the dawn one morning when I went out on a hunt with three aborigines —tall, wiry, half-tame chaps who were willing to take a white man along in exchange for a few plugs of tobacco. They have come to prefer our tobacco to their own native-grown variety made from the leaves of a native narcotic plant. They were dressed in white-man style—flannel shirts and dungaree trousers, but without boots.

They brought along a half-breed dingo (native dog) on a leash, to smell out the tree kangaroos. Two of them carried nulla-nulla (clubs). The natives, Jimmy, Dick, and Joe, had been brought up at a mission and had a good knowledge of English, which they spoke in soft, throaty voices. They told me they always hunted tree kangaroos in the dawn, because the scent was



◂ THE TREE KANGAROO'S long tail is used as a support in climbing. On the ground, the animal jumps like its cousins but with smaller leaps.

▾ WHEN THE ANIMAL springs from one tree to another, the bushy tip on its long tail probably acts as a rudder. Tree kangaroos are found in northern Queensland and on the island of New Guinea.



freshest. They also told me what I'd heard already, that white men rarely saw tree kangaroos. One reason for this is the wild, mountainous country they live in, the other their natural shyness.

We went three miles through thick mountain country before the dingo went on the alert, showing its excitement by giving little whines and pointing its long snout up at a eucalypt in a gully.

The dingo, the Australian native dog, shows signs of its remote northern European wolf ancestry in its large canine teeth. It is thought that this animal must have been brought to Australia by sea, by the Malays or other peoples after the continent became separated from the Asiatic land mass.

The mother of this half-breed dingo had been a cattle dog: her son had a yellowish-brown color inherited from his wild father.

When the dog began bristling, the blacks told me to look up in the branches. I couldn't see anything at first; but as Joe leaped up the trunk with his waddy tucked in his belt, I saw the dark green foliage burst open and a brown tree kangaroo run out along a big limb. The animal was about 80 feet over my head, gripping the branch with its large forepaws. It all happened very quickly: when the limb began to give under the animal's weight, it leaped. In a clean jump it hurtled at least 40 feet away to a branch of another tree, only about 15 feet lower than the one it had left.

Meanwhile Joe was getting higher up the tree. Dick, who was on the ground, raced to the tree into which the kangaroo had jumped and began to clamber up. Jimmy, holding the dingo, stayed by the first tree.

Soon, a second kangaroo was flushed out of the first tree. This one leaped to the ground and made off. I half expected the black to unleash the dingo and take after it, but he didn't.

I stood by and did nothing. I later used my elementary trigonometry to measure that leap. It was every inch of 50 feet. I marveled at the animal's strong bone structure and the padded hind feet that could stand such a fall.

Then there was a commotion overhead. I saw that Joe had grabbed a third tree kangaroo by the tail. The aborigine dug himself into a fork of the tree, gripped with his left hand, wedged his feet, and tugged at the kangaroo's tail. After a minute of grunting from both Joe and his quarry, the 'roo, as the Australians colloquially call it, came crashing to the ground. Before the animal could get to its feet, Jimmy sprang at it and cracked the nulla-nulla on its head. The dog had leaped too, but his help wasn't needed.

Joe climbed down quickly and immediately began clambering up a third tree, near the one into which the first kangaroo had jumped. I saw the reason then: this third tree was the only one within reasonable leaping distance from where the animal now was, even for a tree kangaroo. Joe's presence in the third tree would keep the 'roo from making a leap into it. And so it turned out. Dick climbed up the other tree, caught the 'roo by the tail, and brought it tumbling to the ground, where Jimmy smashed its skull, too.

The two kangaroos, male and female, were different from the land-living kangaroos I had known. Not only were they smaller, but their hind feet were shorter. The pads were broader and had cushioning soles covered with rough granulated skin, much like nonskid tire treads, which must have helped prevent slipping. The hands were very much larger than those of the land kangaroos, with strong curved nails on the fourth and fifth toes—obviously good for gripping.

I noticed differences also in the tail, which was very long and more slender than that of the land variety—rather like an opossum's, except, of course, that it wasn't prehensile. It also had something the land 'roo's tail lacked — a thick, furry tip, which acted as a rudder during the long aerial jumps and as a prop when climbing.

I thought the tree kangaroos looked rather like large Australian opossums. Just how accurate that random observation was I learned when I got back to Sydney and spoke to Ellis Troughton, F.R.Z.S., C.M.Z.S., Curator of Mammals at the Australian Museum. He told me that kangaroos, both tree and land ones, had apparently descended from some common tree-dwelling ancestor.

Return to the Trees

"From these early ancestors, the kangaroo family developed in many ways," Troughton explained. "Most of the members stayed on the ground, where they developed their kangaroo-like appearance, but the present tree kangaroos eventually returned to the trees and began, to some degree, to reverse their shapes toward their early ancestral type."

It wasn't completely evolution in reverse, because there is an irreversible law that features lost because of disuse cannot be regenerated. Thus, the tree kangaroos that returned to the trees, either for safety or for food, did not acquire again the prehensile or grasping ability of foot and tail that their earlier ancestors had had.

But as I saw on another hunt with the blacks at Cooktown, the long tail was quite a handy implement. The kangaroos pressed it against the trunk when climbing and against branches when clambering along them.

The two tree kangaroos we got that first morning belonged to the more northern of the two species found in Australia—Bennett's tree kangaroo, named in 1887 by their discoverer De Vis, after Dr. George Bennett, a famous Australian naturalist.

The other kind is Lumholtz's tree kangaroo, named a few years earlier after the famous Norwegian explorer Dr. Carl Lumholtz. It, too, lives in the tropical rain forests of northern Queensland, but it is found farther south than the Bennett's tree kangaroo.

Bennett's tree kangaroo was called *boongary* by the natives. They told early collectors that it never drank. Certainly it is often found far from water, but in rainy seasons, it is obviously able to get all the water it wants from wet leaves and pockets of water caught in crotches.

According to naturalists, Lumholtz's tree kangaroo spends quite a lot of its time on the ground, climbing into trees to feed on the foliage, to sleep, and to escape when chased by blacks. Although its hind legs are shorter than those of the land 'roos, it hopped speedily on the ground. So did Bennett's tree kangaroo, although the leaps were smaller and the body was inclined well forward to counterbalance the long swinging tail.

On other hunts, I saw tree-kangaroos climbing swiftly up creepers, leaping down 30 feet to a limb, and bounding like a cat on forepaws and feet. They were just as sure-footed. I even saw one asleep in the fork of a low tree, with its tail tucked between its legs as a cat does.

I saw two of them eating vines and wild fruit. Joe and his fellow-hunters told me these kangaroos never eat grass and that they are rarely found below 100 feet. We were shown a spot where an escaping tree 'roo had made a record leap of 70 feet from limb to ground —and had obviously landed unhurt.

On my early morning expeditions, the blacks killed five females. I searched the pouches, but none were carrying young. It was probably too early. They have one young at a time.

Tree kangaroos are a great attraction at any zoo. Sydney's Taronga Zoo has some at the moment, delighting large crowds with their shinning up hanging ropes. This is the first time for many years that an Australian zoo has had them. One of the problems is that they don't live long in captivity unless provided with their natural diet. Taronga Zoo won't find it easy to do this, 1500 miles south of the tree kangaroo's normal habitat. Until naturalists can overcome this dietary snag, you probably won't see tree kangaroos in your zoos, either.

By Louis Dupree

Who saw the Sch'goon?

When an archeologist is called upon to double for Sherlock Holmes, he may have trouble convincing the local people he has caught the right culprit—in this case an animal, which scientists did not know existed in Afghanistan

One day, while my wife and I were digging for traces of earlier people in south-central Afghanistan, the inhabitants of the village came to tell us that their grain was being stolen. We did not want to get involved in local squabbles. Certainly we could do nothing without specific evidence regarding the culprit.

That the grain was being taken had been proved beyond a doubt by a unique "lock" used in these parts. Although this device did not prevent stealing, it let the people know whenever thievery had been committed. When the farmers pile the grain in their storage places, they put fragile clay seals on the grain at intervals of from two to three feet. A design is imprinted on the clay while it is still wet, and when the seals dry, they are so delicate that they will crumble at the slightest touch. If grain in any quantity is removed, the seals will crack and fall to pieces, thus exposing the loss. Only one man in the village carves the wooden seals, so it would be practically impossible to replace a broken one.

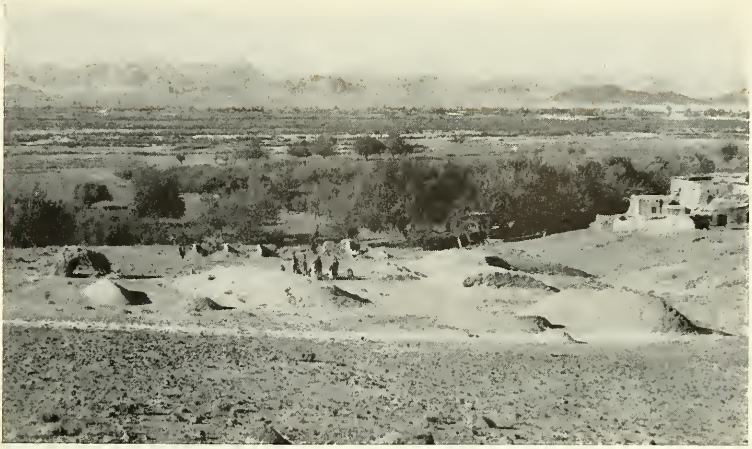
The telltale seals were now being broken every night. But the guards, insofar as they could stay awake, had seen nothing.

Several days later, after returning from digging in a cave, the village council approached and announced that they had discovered where the grain was going. A big, big bird was taking it, they said, a bird with large claws and feathers like camel's-thorn. The headman's son mimicked the bird darting down and swooping away after eating the grain. If his re-enactment was accurate, a veritable roc was menacing the food supply of the village of Badwan.

"Our old guns cannot kill him," they said. "You must kill him for us." The only weapons in the village were a few ancient flint-locks and percussion cap rifles, which made a lot of noise but were very inaccurate. I had a twelve-gauge, pump-operated shotgun, so I agreed to undertake the task. However, I did not look forward to spending most of the night in the cold November air and then working all the next day at the cave.

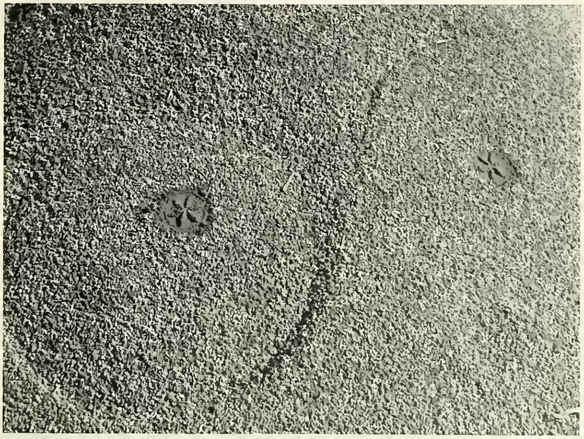
More and more evidence accumulated, and the grain continued to melt away in the night. One of our workmen pointed to a large bird floating lazily in distant circles and stated that it was the culprit. A feather was found on the path near the grain storage area—proof positive, they told us, of the presence of the bird thief. Something must be done to stop the depredations. So one night I got into my sleeping bag early and set the alarm clock for 4:30 A.M.

In the morning, I crawled out and dressed clumsily. Arriving at the grain storage area, I saw only the guards, sound asleep on a pile of straw. I dug a foxhole in the straw and sat watch. All I saw was the changing sky, incredibly brilliant so near the desert and streaked with an unusual number of falling stars. Clouds floated behind the gray-black limestone mountains,

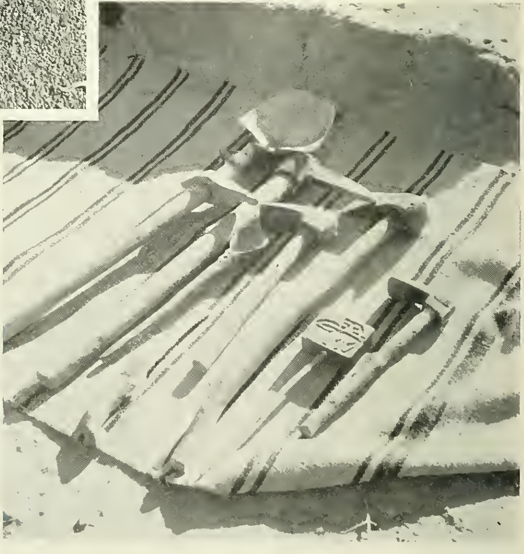


◄ THE STORAGE AREA of Badwan from which the grain was being taken by a mysterious marauder. The guard's hut is at left.

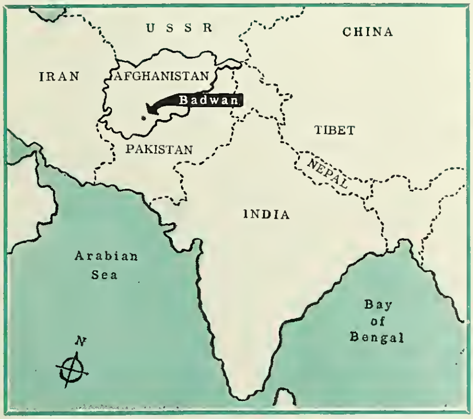
▼ CLOSE-UP of guard's hut.



▲ CLAY IMPRESSIONS of seals that identify ownership of grain and protect against theft. If grain is removed from the pile, the dried impressions break.



▲ ONE OF THE CARVED WOODEN SEALS used in protecting the grain is seen here among the typical tools of a Badwani farmer.


U S S R
CHINA
IRAN
AFGHANISTAN
Badwan
TIBET
PAKISTAN
NEPAL
INDIA
Arabian Sea
Bay of Bengal
N

and presently the full moon disappeared.

Some desert jackals were noisily whooping it up when Homer's "rosy-fingered dawn" reddened the landscape. Badwan quickly awoke and prepared breakfast. While we were eating, the guards came in and reported three more broken clay seals. The "bird" had struck again.

That day, the villagers were noticeably skeptical of my prowess as a hunter.

The next morning, it was freezing when I awoke at 2:30 A.M. and headed for the scene of the crime. As I approached, I saw a medium-sized animal running away from one of the piles of grain. I fired and missed. The shot wakened the guards, who berated me for firing at nothing and insisted that I watch the sky for the bird. When they settled down for a few more hours of sleep, I slumped in my drafty foxhole for another cold night.

The moon was still full. About 4:00 A.M. my waiting was rewarded. I spied the same animal, moving ponderously like a small tank across the grain storage area. It had doubled back and come in behind me. I raised my gun and fired quickly—but missed. The creature began to move rapidly in the direction of the hills. I fired again and scored a hit. Running close, I fired once more, delivering the *coup de grâce*. I looked in amazement at the thief.

A Rare Specimen

The shooting had aroused the village, and several bleary-eyed men, wrapped to the chin in their wool combination blanket coats *(pushtins)*, came out to see the excitement. I proudly showed them my trophy—an enormous porcupine!

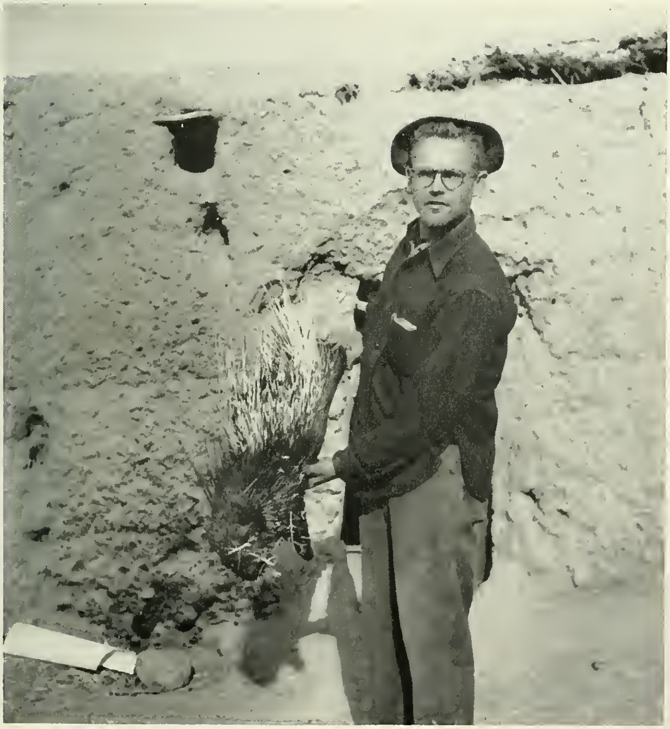
A few of the men grunted disgustedly. One said, "This is not a bird. It's a *sch'goon*."

After sunrise, the whole village inspected the kill and immediately divided into two camps, those who thought the porcupine was the culprit and those who thought I was crazy to kill the porcupine instead of waiting for the bird. Even after the porcupine's stomach had been ripped open and found full of grain, many still defended the "bird" theory.

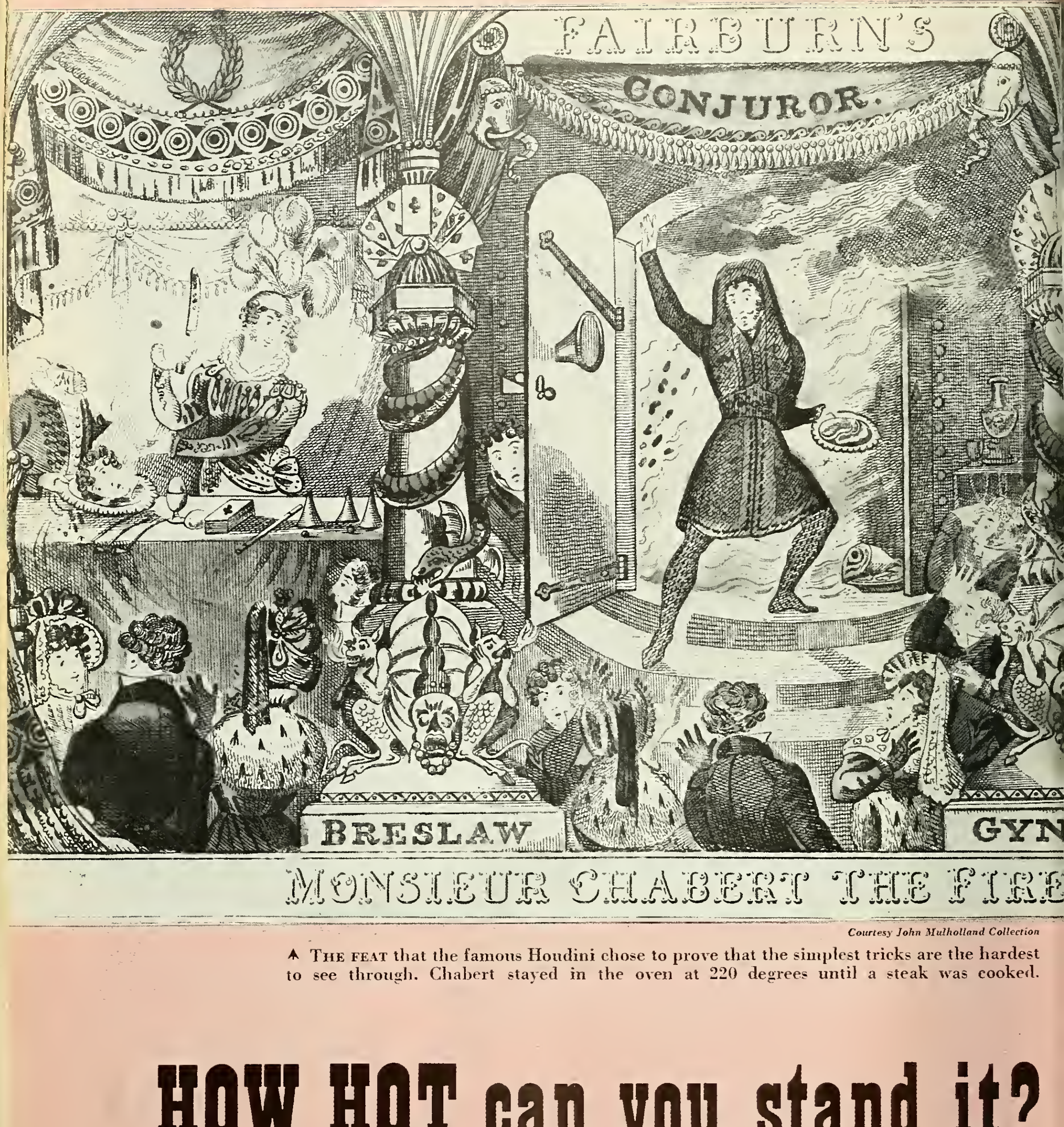
The controversy continued as long as we were in the village. It finally simmered down into a sort of accepted village joke. Several times in the light of the outdoor fires, we saw Badwanis making fun of the people who still held to the bird theory. A man would imitate the flight of a huge bird; then there would be hoots of laughter and a number of bang-bang-bangs.

Not long after returning to the United States, I was compiling a mammal list for Afghanistan and was surprised to find that no one had ever reported a porcupine in that country. Correspondence with one of the world's greatest living mammalogists, T. C. S. Morrison-Scott of the British Museum (Natural History) disclosed that I had killed an Indian Crested Porcupine *(Hystrix indica)*, never before reported from Afghanistan.

Strange things happen to archeologists. We didn't find exactly what we were looking for in that cave where we were excavating, but we did discover a totally unexpected *sch'goon*.



◀ THE AUTHOR with the villain of the piece, an Indian Crested Porcupine.


FAIRBURN'S
CONJUROR.
BRESLAW
GYN
MONSIEUR CHABERT THE FIRE

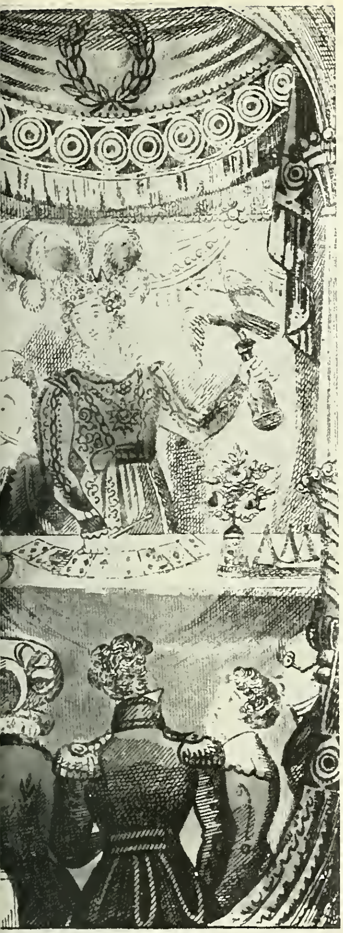
Courtesy John Mulholland Collection

▲ THE FEAT that the famous Houdini chose to prove that the simplest tricks are the hardest to see through. Chabert stayed in the oven at 220 degrees until a steak was cooked.

HOW HOT can you stand it?

Charlatans of old traded on the public's ignorance of human physiology, and even the Royal Society could not replace superstition with science

By VILHJALMUR STEFANSSON *and* OLIVE RATHBUN WILCOX



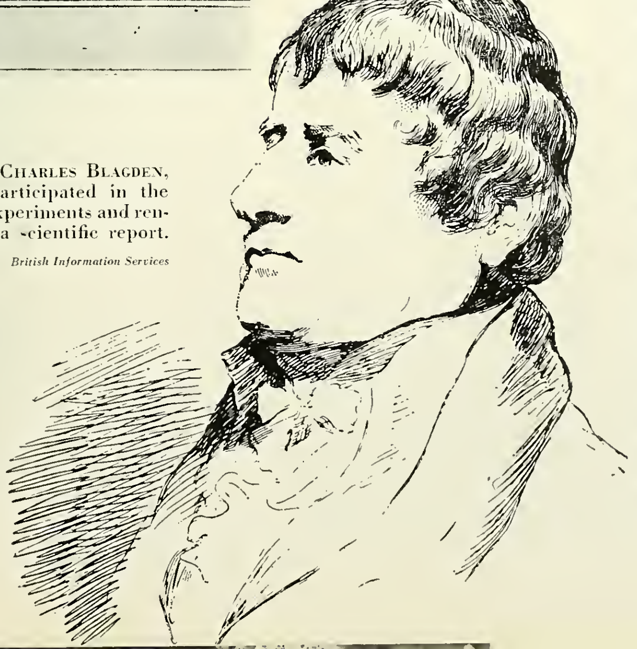
HOUDINI once remarked that the hardest tricks to see through are the simplest ones. Accordingly, the most baffling trick of all is the one in which a magician stands unharmed in an oven that is hot enough to cook a piece of meat hanging near by. This, said Houdini, is practically impossible to see through because it is as simple as a trick can be.

Ivan Ivanitz Chabert (sometimes called. J. Xavier Chabert, A.M., M.D.) startled European audiences in the last century by demonstrating that he was "the only Really Incombustible Phenomenon." Houdini tells us in his book *Miracle Mongers and Their Methods* that Chabert performed in a large iron cabinet resembling a common baker's oven, heated to the usual temperature of such an oven. He remained inside until a leg of mutton was thoroughly cooked. The highest temperature he withstood during a series of performances in London in 1828, according to the London *Mirror*, was 220 degrees (8 degrees above the boiling point of water). He remained in the 6 x 7 foot oven "till a steak was properly done" and afterward returned to his "fiery den for a period of 30 minutes." But Chabert seems to have improved with practice. In Timbs' *Curiosities of London*, published in 1867, it is said that he entered an oven heated to 380 degrees, sang, and cooked two dishes of beefsteaks. He was wearing coarse woolens at the time.

It is strange that the explanation of this feat has not become generally known. Where trickery or supernatural powers are suspected, the public seems willing to swallow any bait, as did the London press in hailing and marveling at Chabert's exhibitions. But where science has sought to get at the truth, there is apt to be a general lack of interest. The ability of the human body to endure extreme heat, and the reasons why it can, became known over 180 years ago. The facts were established by one of the oldest and most orthodox learned societies in Europe. But until recently, the public has remained ignorant and physiologists generally have talked and written as if unaware that the experiments had ever been performed.

Around 1770, a great deal of interest had arisen in both tropical and polar exploration. As a result, the Royal Society of London for Improving Natural Knowledge became interested in questions of extreme heat and cold as related to human survival. On February 16, 1774, the members of the Royal Society heard a paper read by Charles Blagden, Doctor of Medicine and Fellow of the Society, dealing with "Experiments and Observations in an Heated Room."

Benjamin Franklin, a member of the Society, may have been present at this meeting, for he was in London at the time. He was bound to be interested, because he was a student of temperatures and, in fact, invented the Franklin Stove. He had even been associated with three of the experimenters we are about to mention—Banks, Phipps, and Solander. He had participated with them in making possible the publication of one of the first extensive English-language publications on Alaska, J. von Staehlin's *An Account*



➤ DR. CHARLES BLAGDEN, who participated in the oven experiments and rendered a scientific report.

British Information Services

of the New Northern Archipelago Lately Discovered by the Russians.

Charles Blagden, in addressing his fellow-members, described the excitement of being asked by Dr. George Fordyce to witness the ability of the human body to endure much higher temperatures than had formerly been thought possible for any living creature. After experiments with damp heat at temperatures as high as 132 degrees F., Dr. Fordyce had gone on to try himself out against much higher temperatures. He had reached two important conclusions: (1) that dry air does not communicate its heat as does air saturated with moisture and (2) that the evaporation of perspiration from the body in dry air "assists its living power in producing cold."

Confidence in the accuracy of the "unheard-of" tests is inspired by the fact that Blagden was later knighted for his distinguished contributions both to medicine and oceanography and that in 1784 he became Secretary of the Royal Society. Dr. George Fordyce, from whom he had learned these things, also became a member of the Royal Society and served as its Secretary.

Blagden and his three colleagues approached their prolonged exposures to roasting-oven temperatures gingerly, beginning with temperatures only a little above 150 degrees. Gradually increasing the heat, they finally advanced to a temperature beyond 250 degrees F.—38 degrees above the boiling point of water. Their heating device was a cast-iron stove in the center of a room.

At first, Dr. Blagden and his three fellow-experimenters all entered the room together. Finding, however, that their own bodies caused the temperature to sink very fast, they agreed that only one person should go in at a time. Orders were given to raise the fire as much as possible. Dr. Daniel Charles Solander, friend and pupil of the great Linnaeus and at that time on the staff of the British Museum, then entered the room. He had been on expeditions to the Antartic and Iceland, and his fellow scientists may have quipped him about having a chance now to get good and warm, for the thermometer stood at 210°. He described the air as being only unpleasantly hot, very bearable. His respiration was not affected at all. During the 3 minutes he stayed in the room, the temperature sank to 196°.

"The most striking effects," Dr. Blagden asserted, "proceeded from our power of preserving our natural temperature . . . Whenever we breathed on a thermometer, the quicksilver sunk several degrees. Every expiration . . . gave a very pleasant impression of coolness to our nostrils, scorched just before by the hot air rushing against them when we inspired. In the same manner, our now cold breath agreeably cooled our fingers . . . Upon touching my side, it felt cold like a corpse; and yet the actual heat of my body, tried under the tongue . . . was 98 degrees, about a degree higher than its ordinary temperature . . . The same person who felt no inconvenience from air heated to 211 degrees, could not bear quicksilver at 120 degrees, and could just bear rectified spirit of wine at 130 degrees. All the pieces of metal there, even our watch-chains, felt so hot that we could scarcely bear to touch them for a moment, whilst the air, from which the metal had derived all its heat, was only unpleasant. . . ."

Leading Scientists

Remember that these bold experimenters were among the foremost scientists of their day. The baking that Sir Joseph Banks took certainly did not impair his health, for he served as the Society's President longer than anyone else ever did (from 1778 to 1820) and reached the age of 77. He had been a leading scientist in Captain James Cook's antarctic expedition of 1768-71 and had conducted his own expedition to Iceland in 1772, where he investigated, among other things, phenomena of extreme heat resulting from vulcanism. Constantine John Phipps (Lord Mulgrave) was commander of the "Racehorse" on the notable arctic voyage of 1773 and wrote the narrative of that expedition.

Bettmann Ar

Sir Joseph Banks

Dr. Blagden admitted that they experienced some inconvenience: "Our hands shook very much, and we felt a considerable degree of languor and debility; I had also a noise and giddiness in my head . . ." He pointed out that their clothing protected them from the heat on the same principle that it would have from cold. "Underneath we were surrounded by an atmosphere of air, cooled on one side to 98 degrees by being in contact with our bodies, and on the other side heated very slowly, because woolen is such a bad conductor of heat." This, he acknowledged, was similar to observations that had been made in France on girls tending pottery ovens. Dr. Blagden stated that after each of the experiments, he and his fellow scientists went out immediately into the open air without any precaution and experienced no bad effect. The languor and shaking of their hands soon disappeared, and they suffered not the least inconvenience thereafter.

An even more impressive paper by Blagden followed on July 6, 1775, in which he said:

"On the third of April, nearly the same party as before, together with Lord Seaforth, Sir George Home, Mr. Dundas, and Dr. Nooth went to the heated room in which experiments on the 23rd of January were made. Dr. Fordyce had ordered the fire to be lighted the preceding day and kept up all night. . . .

"Soon after our arrival, a ther-

▼ **Dr. George Fordyce** (1736-1802) took the initiative in arranging the oven tests in which Charles Blagden and the three scientists shown here took part.

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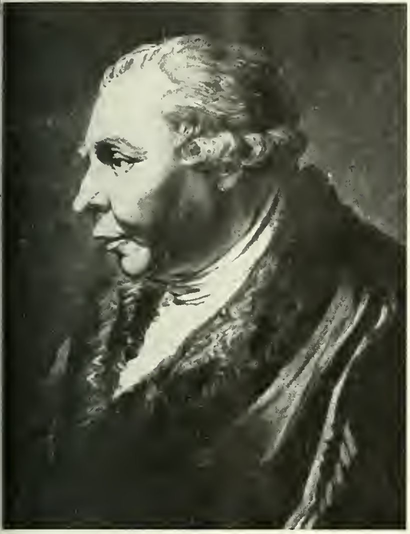
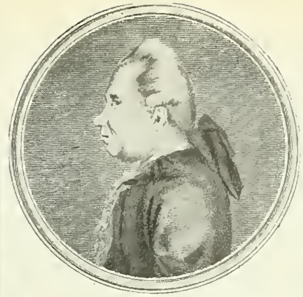


Dr. George Fordyce



Culver Service

Dr. Daniel C. Solander

Constantine John Phipps

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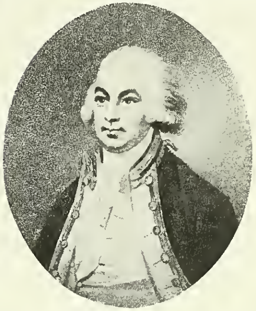


mometer in the room was above the boiling point; this heat we all bore perfectly well and without sensible alteration in the temperature of our bodies. Many repeated trials, in successively higher degrees of heat, gave still more remarkable proofs of our resisting power. The last of these experiments was made about eight o'clock in the evening when the heat was the greatest; a very large thermometer, placed at a distance from the floor of the room . . . rose one or two degrees above 260 degrees; another thermometer, which had been suspended very near the floor, stood some degrees above 240 degrees. . .

"At this time I went into the room, with the addition, to my common clothes, of a pair of thick worsted stockings drawn over my shoes, and reaching some way above my knees; I also put on a pair of gloves, and held a cloth constantly between my face and the cockle [stove]: all these precautions were necessary to guard against the scorching of the red-hot iron [of the stove]. I remained eight minutes . . . The air felt very hot, but still by no means to such a degree as to give pain; on the contrary, I had no doubt of being able to support a much greater heat; and all the gentlemen present, who went into the room, were of the same opinion. I sweated, but not very profusely. [Possibly more perspiration was evaporating than he realized.] For seven minutes my breathing continued perfectly good; but after that time I began to feel an oppression in my lungs, attended with a sense of anxiety; which gradually increasing for the space of a minute, I thought it most prudent to put an end to the experiment, and immediately left the room. My pulse, counted as soon as I came into the cool air . . . was found to beat at the rate of 144 pulsations in a minute, which is more than double its ordinary quickness. . . ."

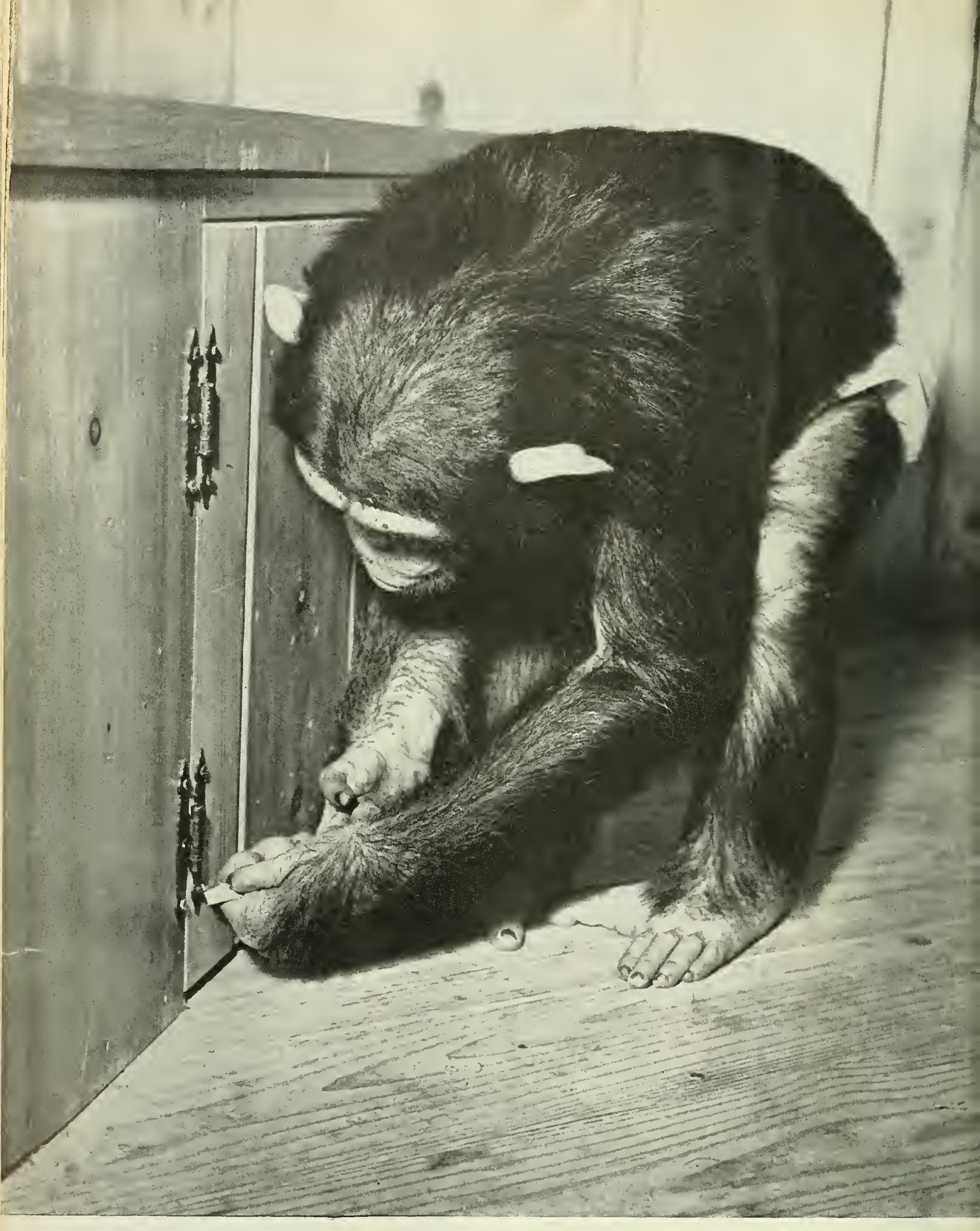
Wanting to ascertain the effect of clothing under these conditions, Dr. Blagden took off his coat, waistcoat, and shirt and went into the room as soon as the thermometer had risen above the boiling point. "The first impression of the heated air on my naked body," he reported, "was much more disagreeable than I had ever felt it through my clothes; but in five or six minutes a profuse sweat broke out which gave me instant relief . . ."

At the end of 12 minutes, the thermometer had risen almost to 220 degrees. He thereupon left the room, very much fatigued but not otherwise "disordered," with his pulse at 136.

He and his confreres later went in many times without shirts when the temperature was almost 260 degrees and bore the heat well. Blagden stated clearly the principle that permitted them to endure these temperatures—the cooling effect of evaporation. Without perspiration, the effect would have been disastrous, as was shown when they put some eggs and beefsteak in the room and cooked them in periods of time ranging from 13 to 47 minutes.

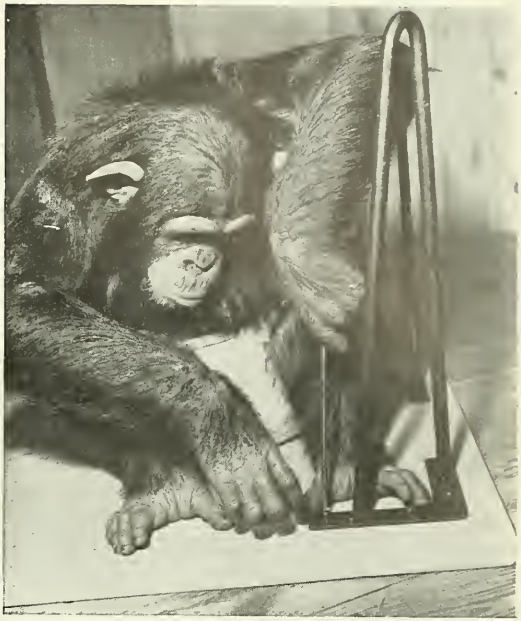
The interest aroused by these experiments led to other tests at the Public Hospital in Liverpool, and the results were similar.

But the public appears not to have grasped the meaning of these tests, and after 1775, scientific interest in them waned, perhaps through the shift of attention to North America, where a war threatened. Well before 1800, the magicians were back at the old stand, astonishing audiences by emerging from furnaces with roasted mutton or well-done sirloin. As so often before in the history of science, the answers were known to a few long before the implications were realized by many. So remember Fordyce and Blagden the next time a magician demonstrates his supernatural powers to resist heat. The explanation, as Blagden pointed out, is perspiration. The body can "keep cool" so long as it can produce moisture to be evaporated. As Houdini put it, this feat might be called the most difficult trick in the world to see through because it is one of the easiest to perform. Or, to put it another way, the reason audiences have difficulty seeing through this trick is that it isn't a trick at all, it's simply human physiology.



▲ NOTHING was safe when Christine had a screw driver in her hands.

▼ At three and a half, she could put screws in tight.



Try, Try Again

How far can a young chimpanzee go with the family tool box if given a little help?

By Lilo Hess

My three-and-a-half-year-old chimpanzee, Christine, has been brought up like a child in the home. She has developed into a strange mixture of smart animal and slow child.

When she was between six months and one year old, I used to compare her development with that of children about the same age and found that Christine usually came out on top. She seemed quite a bit ahead in many ways. She learned more quickly, was more alert and aware of her surroundings, and was stronger and had better control of her body.

Even at the age of two, the difference between her and a human child was not too great. Most children, though talking at that age, have by no means mastered the language, and their words are often only understandable to the "initiated." Christine also had a fairly good chimp "vocabulary," which I had learned to understand perfectly. She also used gestures to indicate her wishes. But the differences were clear. A child quickly grasps the symbolic nature of language and at about the age of two would be learning rapidly to use words and phrases with specific meanings. The chimp, on the other hand, learns to understand a more limited range of words and gestures, and these are more broadly generalized in their application than a child's.

So now, at the age of three-and-a-half, I see the bridge leading further and further away from the human path.

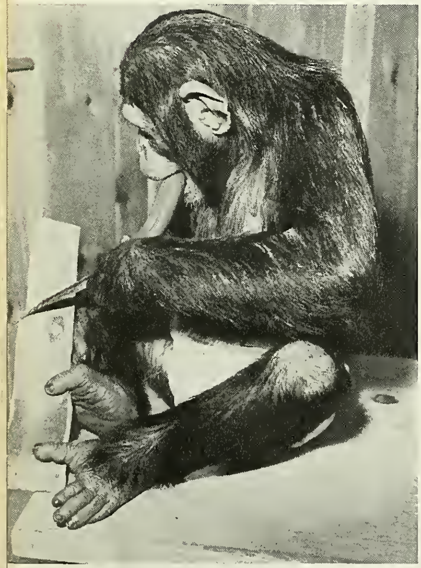
It would not be fair to compare Christine to a backward child. Her behavior is not below standard; it is only different. She did not stop developing; she is branching out in a different direction.

Some situations, however, still show her in better control than a child of the same age. Others put her at about the same level of response, and many show her to be below the mental ability of a human child.

To start with the last, she still gets fun out of the same type of games and toys that amused her at the age of two. Her upright walk has not improved very much. She walks on all fours about 70 per cent of the time. She still chews up things she likes and then cries because they are gone. Like the child of three-and-a-half, she loves to scribble and

▲ AFTER she took a chair apart, she tried unsuccessfully to put it back together again.

▼ A MOUTH can be handy if four hands are not enough to do the job.



▲ THE CARPENTER'S RULE interested Christine, but of course she did not understand that it was used for measuring.

fingerpaint and has a good sense of color. She likes to look at pictures and is capable of recognizing familiar objects. She understands most things said to her and can recognize words and sentences even on the radio.

She tops the child in quickness of reactions, in strength, and in physical ability. In some of her games, she displays remarkable understanding. Her love of tools and the way she handles them would surprise anyone not familiar with chimpanzees. Most three-and-a-half-year-olds like to hammer and take things apart and try to put them together again, but most of them do not work on a thing with such serious concentration as Christine does. The minute she sees someone pick up a screw driver or hammer, she gets very excited and says *ahh-ahh-ahh*, which is her expression for "good" (food, toys, presents, etc.). She will look immediately for a tool of her own. If she can't find one and her motions for "please" are ignored, she will "steal" or take by force the tool that is held by someone else. She likes best to "work" alongside a person but can also amuse herself for a very long time alone with tools. Toy tools do not interest her very much.

The Mysterious Screw Driver

When she was about two years old, this fascination for tools just became noticeable, and it grew increasingly. Her first efforts were to take things apart. She usually used a screw driver to pry them loose, and this needed no demonstration; she just seemed to know. But to turn a screw in the correct manner presented a problem. She could not make her wrist turn. But she never gave up. She would try time and time again. Showing her how to do it did not seem to help. Then finally, one day, when she was almost three years old, she succeeded at her project. She became so excited that her *ahh-ahh-ahh* sounds

▲ SHE LIKED to sit inside an old wooden butter bowl and sand it.

were sputtered and stammered.

That was a day of triumph for her, but it was a black-letter day in my house. Thereafter, she had to be watched continually when she had a screw driver in her hand. No light plug, bolt, or door lock was safe. Yet she could only turn her wrist one way—to take a screw out. She tried to put screws in, but for many months it did not work. Then one day she managed to master this art as well. Now at three-and-a-half years of age, the screw driver is still her great love. But she is also very fond of sandpapering wood, hammering, and even sawing.

She had often watched me sand down a piece of furniture and had also "helped," but her accomplishments were never very visible. One day I gave her an old wooden bowl to work on, and she really stuck with it until it was almost done. She loved to sand the edges of the bowl while sitting in it. Though her work was usually rather meaningless, once in a while she would show real understanding and purpose. Even though the result was far from perfect, the fact that she seemed to plan and execute a job seemed remarkable to me.

▲ Not every stroke would hit the nail on the head.

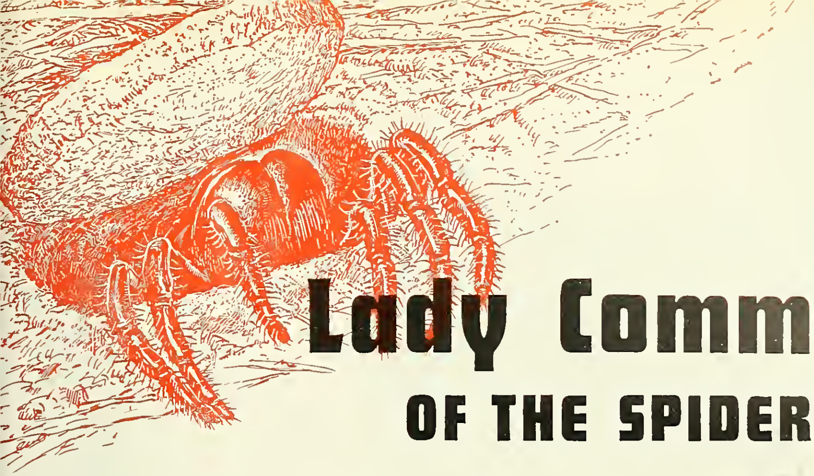
▼ When finally the stool was mended so it would hold her weight, she seemed a little disappointed.

The best work she did was on a little three-legged stool that had broken in half. One side had one leg, the other had two. The minute she had access to the toolbox (it was carefully locked all the time), she brought out the tool and tried to hammer the two parts together without a nail. Then she came and said "please" in her way, and I gave her a piece of wood and showed her where to saw it off. She sawed it fairly straight. I put the piece of wood on the underside of the two broken pieces of the stool, handed her three nails, and told her to put them in. I did not show where the nails should go, but she got them in after a fashion, hammering away furiously. Before she had them in tight, though, she turned the stool over and tried to sit on it. The legs collapsed right away, throwing Christine on the floor. She picked up the pieces and the hammer and started all over again.

Each time when she thought she had the pieces tight, she would try to sit on the stool, and it would collapse again. Unfortunately, I did not count the number of times she repeated her efforts, but it must have been about eight or ten. Finally, I helped out a little, and when she tried the stool and it held together, she seemed surprised and a little disappointed. She wiggled back and forth on it, and when it still did not give way, she abandoned it to turn to something else.

Another tool she likes is a bottle opener. She does not like it for itself but for the result. She still likes certain baby foods and is very fond of soda pops. She can pry the caps off the jars or bottles, but she has to struggle hard to do it. She never uses the bottle opener for any other purpose, but the screw driver doubles as a stick for retrieving objects beyond her reach or as a passkey to jimmy locks open, or as a weapon to beat off some animal (usually the dog).

The accompanying photographs will help the reader to see how Christine reacts to certain objects and situations in the home.



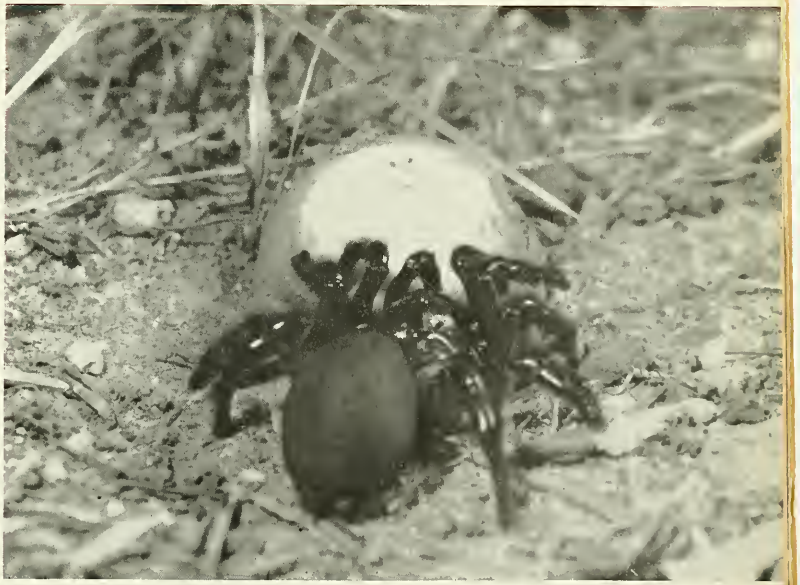
By
JACK C. COUFFER*

Lady Commando
OF THE SPIDER WORLD

Reduce yourself to sow-bug size, and the trap-door spider, pouncing from her hidden lair, will seem a monster incomparably horrid

WHERE the city of Los Angeles ends to the north, dry hills rise up, first in low mounds but farther on in the high peaks of mountains. In the mountains there are wild animals of many kinds — deer, mountain lions, coyotes, and bobcats — which have been pushed back by the growth of the city. But on the grassy slopes at the very edge of the metropolis, there live wild creatures of other kinds, some even more strange and fierce than the inhabitants of the primitive canyons and mountain peaks.

From the vacant lots within the city limits to the chaparral slopes of the desert foothills, or indeed on nearly any hillside in southern California, one may discover the hidden door of a trap-door spider. Our spider is called the Common California Trap-door Spider, *Bothriocyrtum californicum*. It is common, to be sure, but people do not often see it. Trap-door spiders of many varieties are widely distributed throughout the world, but they are always secretive. And each local kind has its own unique habits. The doors that our spider builds are camouflaged with bits of grass and green moss, and are built with fine precision. So far as I know, only the females construct them.



▲ WORKING ON THE DOOR to her hide-out. The two dark marks near the edge of the door are "hand holes" into which the spider inserts her fangs when holding the door shut.

On several occasions while walking in the foothills, I had seen the carefully hinged doors. They aroused my curiosity, and I wanted to photograph the trap-door spider at work. I knew that to do so I must

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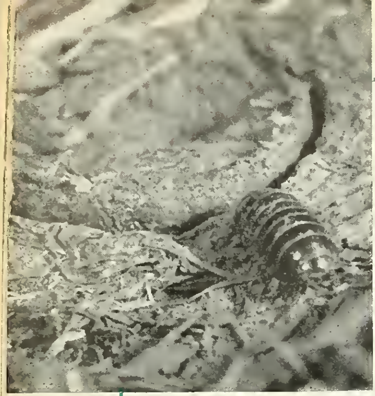
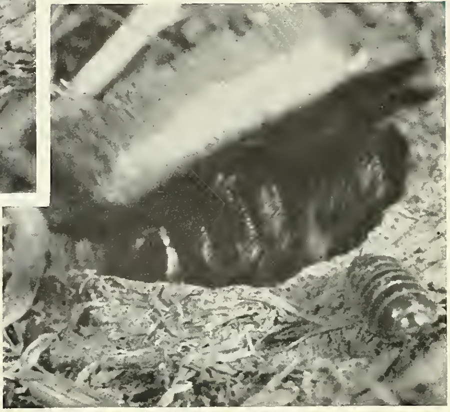
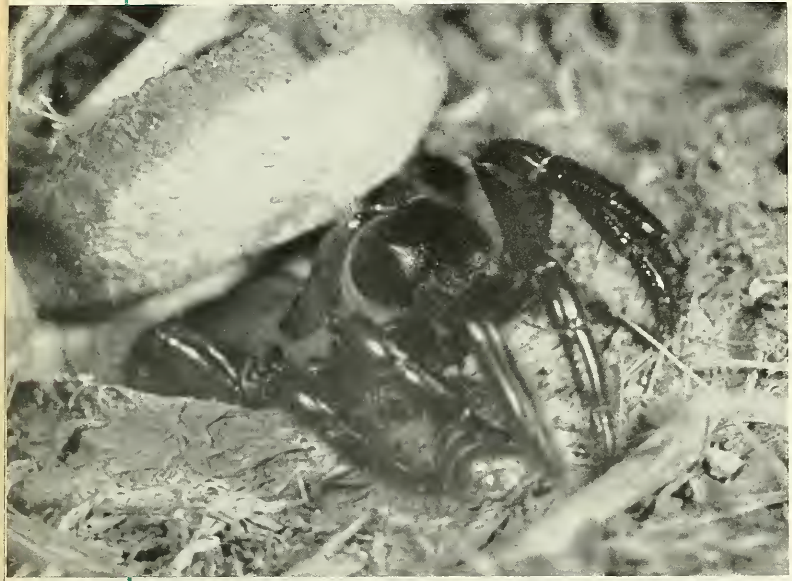
**The author of this article, at 30, has collected and classified vertebrate specimens for the Los Angeles County Museum, participated in an Army-Navy-Marine Corps project to determine the usefulness of bats to the military, sailed small boats around the Pacific, been a commercial fisherman, and done motion pictures for Walt Disney's True-life Adventure Series. He has recently returned from eight months in the Galapagos Islands, to which he and two companions sailed in a 30-foot boat. An article from that expedition will appear in a forthcoming issue of* NATURAL HISTORY.—ED.



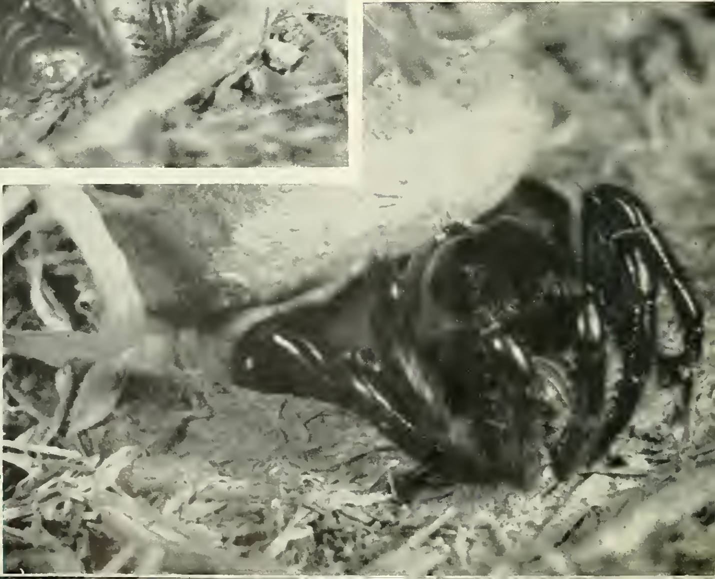
◄ In the silk-lined hole beneath her door, the trap-door spider awaits the vibrations of a passing insect's footfall.



► When the vibrations tell her that her prey is within reach — but not before — she suddenly emerges . . .



▲ . . . to pounce upon the insect. She bars the sow bug's escape with her forelegs and is careful not to let the door close behind her.



► The sow bug curls into a protective ball but is doomed in the embrace of the spider, whose legs gather the insect in.

study the animal's home life and learn all that I could of its behavior. My first step, therefore, must be simply to watch.

I drove to the edge of the city, parked my car, and climbed slowly toward the summit of a knoll above the Cahuenga Freeway. I climbed slowly and watched the ground carefully as I moved, because the hidden home of a trap-door spider is not easy to find. Now and then, I would drop to one knee and bend the dry grass back, the better to see the earth beneath. If anyone had been watching me, he might have thought I had lost my wallet.

More than an hour passed before I found what I was seeking. It was near the summit, close to a bucket-sized rock that jutted from the soil. Bending down, I inserted the tip of my pocketknife into the crack of the spider's door and levered it ajar. Looking into the crack, I could see the spider holding onto the bottom surface of her door. She was braced against the sides of the hole, and she held the door down with her sharp fangs by inserting them into two holes that were punched into the tough layer of tightly woven silk that lined the door and walls of her foot-deep burrow. The spider held so tightly that the blade took a good bend.

I then released the door, for I

wanted to return after dark and observe the spider at night when she would be active. The door immediately slammed shut, and I could see it buckle slightly as the frightened spider pulled it down yet tighter. It fit like a cork in the neck of a wine bottle. The joint was so neat that I had to look closely to see the thin arc where the lid met the soil.

When I returned that evening, the hills were dark against the pale moonlit sky. Masses of white clouds, made luminous by the moon and the glow from the lights of Los Angeles, brightened the slopes and foretold a coming rain. I found the rock landmark and sat quietly. Squinting closely in the reflected light, I could now make out the disc of the spider's nest even without my flashlight.

It was late in spring, but the evening was cool. A breeze moved down the canyon, chilling the ground. It was quiet out here, and the near-by city seemed remote. I sat patiently watching the door of the spider's home for an hour, then impatiently for another hour, yet there was no movement. Except for the cold wind rustling the grasses, nothing stirred, and I sat as still as the stone lest I frighten the spider. A light rain began to fall, barely dampening the ground, and then stopped. I began to shiver.

Then I thought I noticed a movement at the door. I watched it closely, but nothing happened, and I thought that perhaps I had been mistaken. But presently I saw the door rise ever so slightly, just a fraction of an inch. The spider was there, I knew—waiting. She would wait all through the long night, listening for the footfall of some ground-foraging insect. Her prey must pass within reach of her vestibule so she could reach out and snatch it in, for she would rarely allow the lid to close behind her.

Now, from the damp grass a foot from the hole, I saw a slight movement. The grass bent aside revealing a small sow bug—an insect about the size of an aspirin tablet. The bug moved erratically across the ground —searching here, turning there, bumping into a twig, and turning back, but its general direction was toward the hidden spider.

The door rose slightly again. A narrow black line appeared at its lip. The spider obviously could not see the sow bug from her position. These nocturnal spiders have very poor eyes and use them mainly for distinguishing light and dark. Yet she seemed aware of its approach. She could feel the vibrations from the insect's movement across the ground. The sow bug continued on its way. The door moved ever so slightly again. Peering closely into the gap, I could see clearly the reflection from the moon on something beneath the black line—a glint from the spider's polished chelicerae or carapace.

There was uncanny suspense as I watched the sow bug blunder toward death. It assumed, somehow, a personality. The spider now seemed to be fidgeting with anticipation. Again the lid moved — a barely perceptible movement — but from it I thought I could interpret the spider's impatient suspense. I was rooted to the rock, staring into the dimness. To my ears there was a deathly silence — only the occasional muffled sounds of the city, a far-off siren, a train.

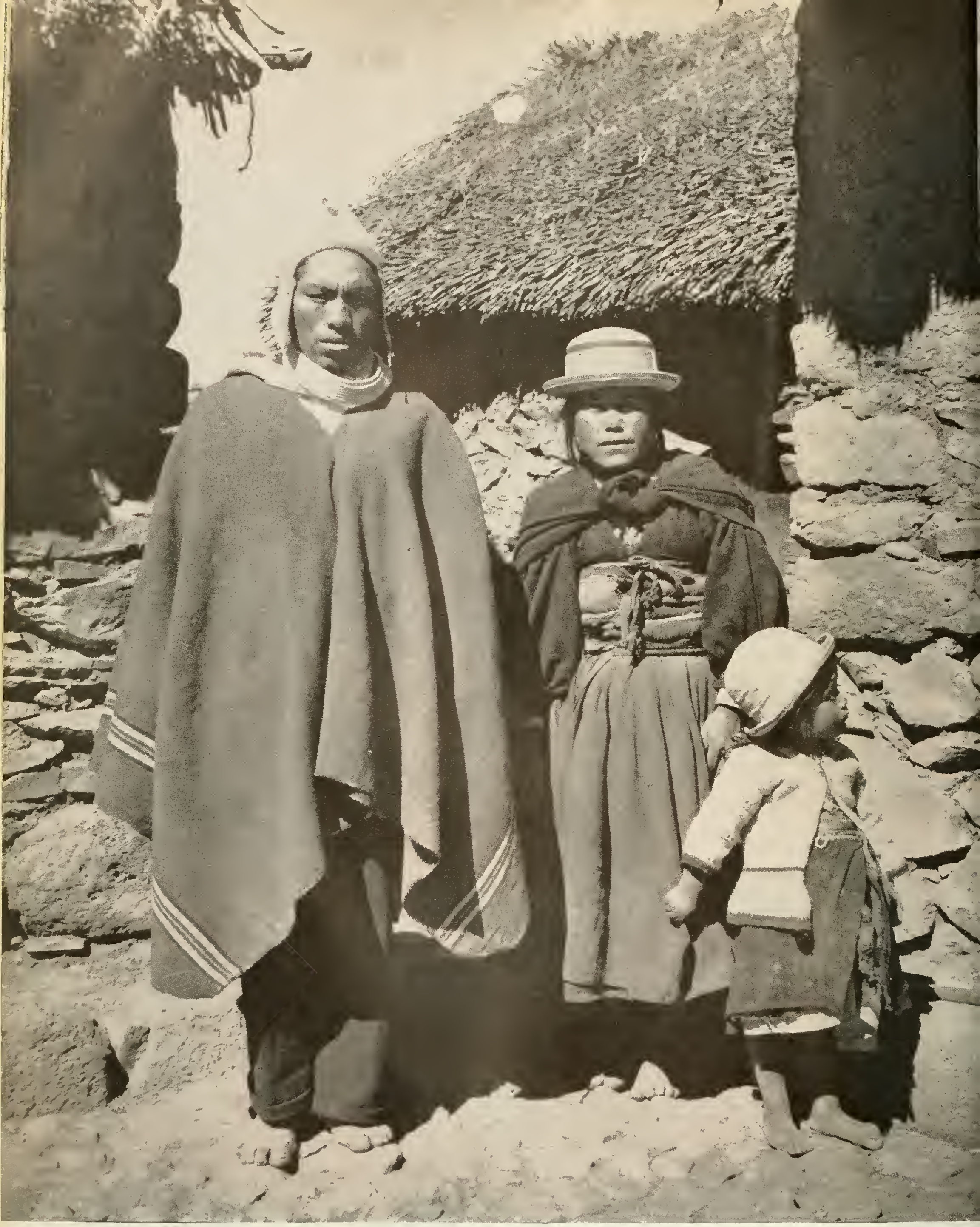
Now the insect was but an inch from the hole. The scene that I was watching suggested a fantasy more terrifying than any science fiction. The sow bug walked brazenly, unknowingly, along a path that led directly in front of the spider's vestibule. Now the insect was nearly past the hole, yet the spider beneath the door did not move. Surely she was aware, yet the door did not move. It was a part of the soil. From the black slit where the door stood slightly ajar there was not a sign of life. Now the sow bug seemed almost out of danger.

Suddenly, the spider, like a black monster, threw herself forward blanketing the bug with her grasping forelegs. With a single movement, she leaped half out, seized the sow bug, and dropped out of sight again. The door snapped shut with a sharp hollow sound.

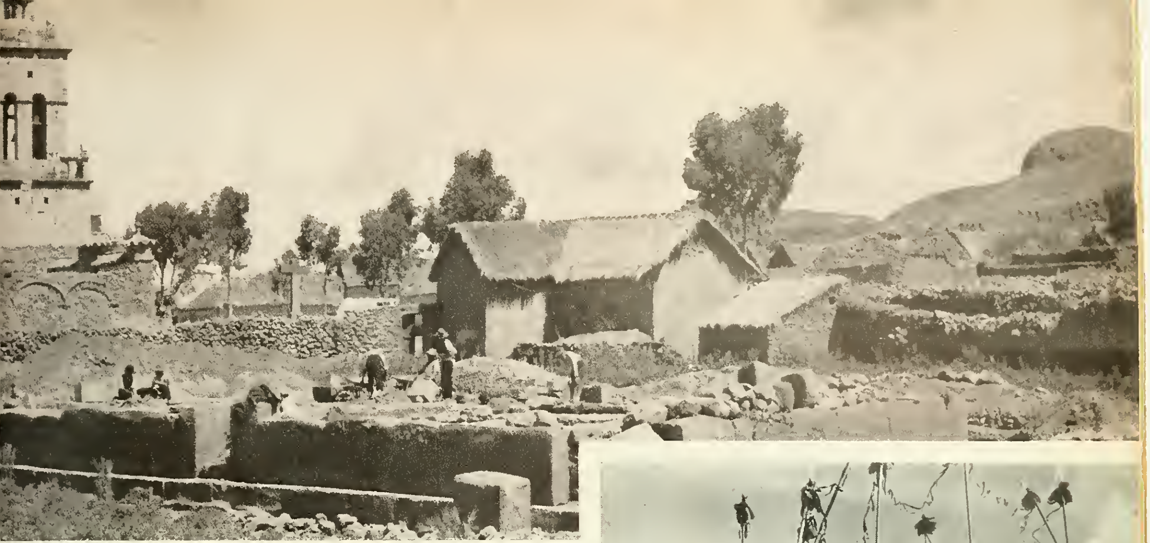
Even though I had been expecting it, the spider's sudden action startled me. Watching the approach of the sow bug, I had lost all contact with the world of man. But now I again felt the wind and was aware that it was raining lightly once more. I felt chilled, and a short time later, passing through the darkened streets of the city, I was thankful that every hidden manhole-cover did not conceal a black monster, ready to spring forth and drag its victim into the earth.

THE SPIDER draws her prey nto the hole, allowing the oor to close behind her . . .

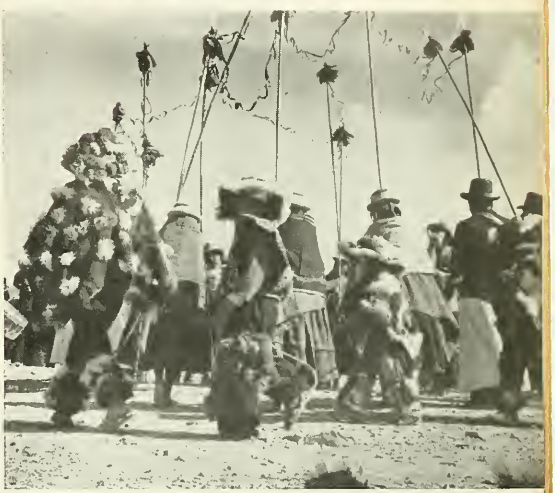
▼ . . . and within half a second, the lady commando has completed the assassination and is below in her "parlor" ready to suck the juices from her prey.



▲ AN AYMARA FAMILY, dressed in their fiesta best and ready to set out on their annual pilgrimage to the shrine of San Bartolomé, where the ancient Chokela ceremony was enacted.



⮝ **Chucuito** is an ancient village. Here a building of Inca times is being excavated near a seventeenth century Spanish church tower. In the distance at right rises the rocky dome of San Bartolomé.



➤ A **scene** in the time-honored ceremony. The Chokelas cavort, snapping their slings, while in the center a man darts to and fro, brandishing a small stuffed animal.

Who were The Old Men of the Mountains?

An exploration into the spiritual life of the present-day people of Inca-land

By Harry Tschopik, Jr.

Assistant Curator of Ethnology
The American Museum of Natural History

All Photographs by the Author

"THIS is it!" I thought to myself as the horses plodded up the steep trail toward the shrine of San Bartolomé. Already a multitude of figures, ant-size in the distance, were gathering on the rocky dome just below the summit of Atoja Mountain.

The shrill melody of panpipes drifted across the upland meadows, and thudding drums re-echoed among lofty sandstone crags. From far away came the thin, reedy drone of cane flutes, wailing melancholy tunes composed centuries before Columbus sailed for the New World. Files of Aymara Indians, dressed in their fiesta finery, were climbing the canyons and winding across the barren grasslands of the altiplano, the high plateau of Peru.

I turned in the saddle. Behind and far below, the village of Chucuito lay sprawled like a toy overlooking the Bay of Puno and the blue waters of Lake Titicaca beyond. Across the frontier, in Bolivia, gigantic Andean snow peaks glittered in the cold air of early morning.

Where the trail widened, my interpreter Clemente reined in and dismounted. "Let's rest the horses," he said. "The shrine is over 15,000 feet high, and horses have to go slow at this altitude."

I sympathized with the sweating animals, but still I wanted to get to the top as quickly as possible. "We don't want to miss the Chokelas," I objected. Above all else, this was what I had come to Peru to see.

"There's no rush," said my wife, seating herself on a boulder and lighting a cigarette. "They are way behind us, down there," she pointed. "They've stopped for a drink and a chew of coca."

There, 1000 feet below, near a clump of stunted *quenua* trees, the Chokelas were conversing idly. A bottle of pisco brandy was making the rounds, and the masked dancers were in no hurry to be on their way. Their inactivity made me all the more restless.

The members of this little group were about to enact an age-old rite, which they performed each year on the third of May. They could not know that their ritual was perhaps the only major ceremony that has survived from Inca times to the present day. In some strange way, this particular rite managed to escape the centuries-long campaign of the Spanish conquerors to stamp out paganism in the Andes.

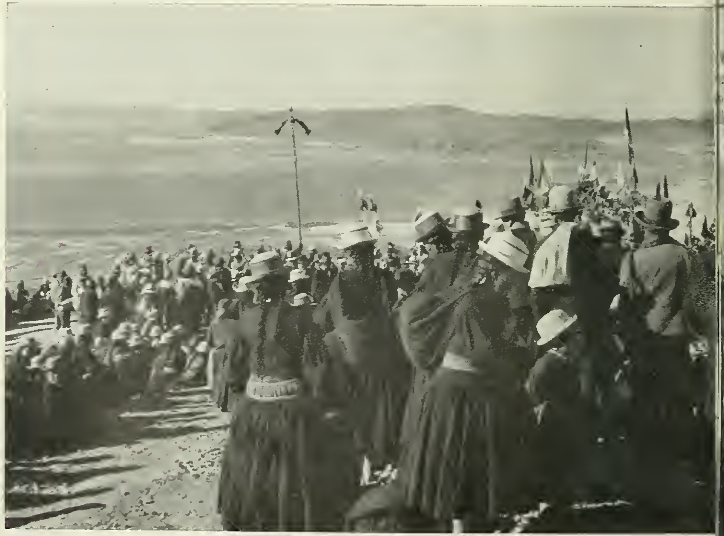
My wife and I had come to Peru to discover whether the customs of the modern Indians could tell us anything about the civilization of the Incas who, during the sixteenth century, ruled the Andes from Ecuador to Chile. We had made Chucuito our headquarters and had set up housekeeping in the village. Gradually, little by little, we had begun to coax information from the sullen, suspicious Aymara Indians.

We learned that, despite four centuries of Spanish domination, the Aymaras preserved an astonishing number of their aboriginal customs. As, day by day, the pattern of their culture was unfolded to us, it became apparent that much of their ancient religion still existed—at least in secret.

But on the subjects of religion, magic, and sorcery, the Aymaras were reluctant to speak. Was witchcraft still practiced? No, certainly not in Chucuito. "The Incas," I would mention casually, "used to sacrifice animals to their gods. Do the Aymaras ever do such things?"

"Animal sacrifices are forbidden by the Church!" would be the shocked reply.

One day, within the hearing of our Indian houseboy Manuel, I asked an old Aymara whether masked dances were still performed in Chucuito.



< MANUEL, the houseboy, who mentioned the Old Men of the Mountains and then refused to say more because he was a good Christian.

^ HUNDREDS OF INDIANS gathering on the rocky knoll. In the foreground a group of Pilgrims gaze at the shrine. Beyond, a Maypole dance is in progress.

"I have seen them in Juli [a town some distance away]," said the Aymara. "Why don't you go there?"

I felt furious and frustrated. Manuel glanced at me shyly, started to speak, and decided against it.

Later that evening, while clearing dinner away, Manuel hesitated.

"There are the Chokelas," he said simply.

"The what?"

"You asked that old man about masked dances. There are the Chokelas," he repeated.

Trying not to appear especially interested, I inquired casually, "Who and what are the Chokelas?"

"They dance on the third of May at the shrine of San Bartolomé. Some say that they are the old men of the mountains. Some say that they are heathen spirits. But I am a good Christian," and Manuel carried the dishes to the kitchen.

I first heard about the Chokelas in mid-April. They sounded most promising, but no one knew who they were—or would admit it. They were old men. They were young boys. They were clowns. They were mountain spirits. I vowed that I would find out about the Chokelas if it took me a year. As it turned out, it took a little longer than that, and in the process I learned a good bit about Aymara religion.

A Long Climb and a Long Search

Now, on the trail below, the Chokelas collected themselves, adjusted their masks, and resumed the long climb to San Bartolomé. We remounted the horses, and a pack train of llamas padded by on silent feet, throwing us haughty glances as they passed. Their drivers tossed stones on a cairn beside the trail, murmured brief prayers for long lives and prosperity, and clambered ahead, up the stony roadway.

Suddenly the trail was joined by other paths, and the traffic became congested. Bands of musicians playing panpipes and banging drums and cymbals jogged by, their female companions twirling yarn tassels and shouting in high-pitched voices. Vendors of candies and *chicha* beer cried their wares, children laughed and wept, dogs snarled and barked. Clouds of dust swirled until they darkened the sun. The trails were crowded with jostling Indians and llamas headed for the Fiesta of the Cross of San Bartolomé.

The summit of the knoll was bedlam. Worshipers knelt in crowds before the great Christian altar, built over a pagan altar, facing east. The shrine itself was bedecked with flags, paper serpentine, candles, tinsel, and artificial flowers. Pungent smoke of *copal* incense clouded the air. Beyond, through the arches of an adobe colonnade, the landscape dropped away dizzily to microscopic farms, thousands of feet below.

On every side, dancers stomped and gyrated to the disharmonic music of a dozen bands. Pilgrims mumbled prayers, and a cripple stumbled on his crutches toward the shrine. In the center of the crowd, young girls twirled around a Maypole, their heavy woolen skirts swirling in concentric circles of pink, yellow, purple, and green. The maneuvers of the dancers wove patterns in colored ribbons around

▲ STUDYING the sacred leaves of coca—the leaf from which cocaine is extracted—old Eusebio was able to supply answers to some puzzling problems. But at mention of the Chokelas, his reserve descended like a curtain.

As ON ALL AYMARA FEAST DAYS, a market is in
gress. During the Fiesta of the Cross, animals
ed of bread are sold or bartered. The woman
he foreground offers miniature vicuñas.

the Maypole shaft, surmounted by a silver image of the dove of peace. Drunks, wrestling and clawing at the brink of the precipice, were pulled apart by their women. Lovers crept down the hillside. In the shadows of boulders, mothers nursed their infants. The llamas huddled, heads together, chewing their cuds.

We pushed our way through the wall of screaming, singing, dancing Indians, searching for the Chokelas. We found them behind the altar, circling slowly, oblivious of their surroundings. The men were playing a sad, repetitious tune on long end-flutes. The women, carrying tall poles connected by woolen cords, were executing an endless, dispirited posture dance. But the words of their chant were drowned by the noise of revelry around them. One man, clutching a battered stuffed animal, darted wildly about the circle. Crowds of milling spectators added to the confusion.

"What are those?" I shouted over the din to Clemente. A number of grotesque figures, dressed in ragged ponchos and wearing shapeless fur masks, were leaping and cavorting around the circle of flute players and chanting women.

"They are called 'grandfathers.' Don't ask me why!"

"*Grandfathers!*" I cried incredulously.

They didn't behave like grandfathers. One of them snapped his woven woolen sling in the air and snatched off the hat of a startled spectator. Another threw a handful of dirt into the lens of my camera and then kicked a fellow "grandfather" squarely in the seat of the pants, grunting all the while with gutteral, animal-like noises. A third, under four feet tall, poured water down the collar of a small girl, who, pressed against the crowd, was unable to escape.

Suddenly the man with the stuffed animal took off at a run down the hillside, with the "grandfathers" in hot pursuit, screeching and whooping. We hastened to follow, but a long chain of dancers careened by, blocking the way. Fighting our way through the mob, we became enmeshed in the ribbons of another Maypole group.

Hundreds of Indians now jammed the plaza around the shrine. As the day wore on, the fiesta became even more frenzied; and still troops of dancing, shouting Indians continued to arrive. It was difficult to see through the curtain of dust. It was almost impossible to speak or be heard.

The "Grandfathers" Huddle

Eventually we located the Chokelas again. The flute players and the chorus of women had now formed two swaying lines. Before them, crouched in a huddle, were the "grandfathers." They were performing their most secret rite—but we were not to see it. Besides being partly screened by spectators, the masked performers were completely hidden under a thick layer of overspread ponchos. Tantalizingly, smoke curled from beneath the animated mound of cloth. An hour passed, and muffled noises emerged.

Suddenly, several "grandfathers" crawled out, pelted the onlookers with cooked meat, and rushed away into the crowd. The audience screamed and cheered. The man with the stuffed animal reappeared, brandishing it high and darting about as though possessed. The flute players and female chorus stopped for a drink of brandy. Toward the west, the setting sun turned fiery red.

In little groups the Indians began to descend the dome of San Bartolomé. Within minutes the shrine was almost deserted.

"Well," sighed my wife, "we've seen it. That is, I *suppose* we have."

Seen it? Seen what? I felt cheated. I hadn't the slightest idea what had occurred.

"That old man," I cried to Clemente, pointing. "The one pouring brandy for the Chokelas. I know him! It's old Eusebio Choque!"

We mounted the horses for the descent to the village.

"I know him!" I repeated, clutching at a straw. "Tomorrow we will talk with Eusebio. I think he and I have a lot to discuss."

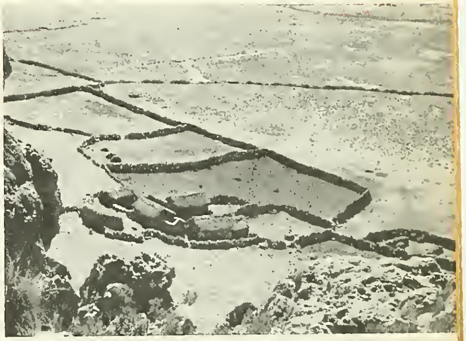
Old Eusebio lived in a small thatched hut on the outskirts of the village. I had talked with him many times during the past months but mainly about such pedestrian topics as farming, fishing, and marketing. Purposely I had avoided subjects the Aymaras were reluctant to discuss. Now it was time to talk about more esoteric things.

As Clemente and I approached,

➤ MARTIN (left) had been "killed" by lightning and when not fishing was studying to become a magician.

▲ **Manuel Barrientos**, master-magician of Chicuito. Fear that the younger Aymaras were losing their respect for the old ways finally led him to share some of his most closely-guarded secrets.

Here in the solitude of the high pastures, Manuel passed much of his time tending his llamas. Below: His houses and corrals in the lonely *puna* country.



we saw that the old man was not alone. He sat in the patio before his house, listening thoughtfully. A young woman was explaining something in an excited, tearful voice.

"——and that's the way it's been, *tata* Eusebio. Everything has gone wrong. First, during Carnival, it was the seed potatoes. Three large bags of them just disappeared."

She sniffled and continued, "And later my best skirt. I had just washed it and spread it out to dry. When I went back to get it, it was gone." She burst into tears.

"And now my llama. It is missing for three days, and I have looked everywhere. Is somebody stealing my things?" she asked. "Read the coca, *tata* Eusebio."

The old man reached into his coca bag and scattered a handful of leaves on a cloth spread out on the ground. He studied them intently.

"No one is stealing your things," he said. "Maybe it is the grandfather at the place where you live. Maybe you have been neglecting him."

Grandfathers again. Aymara grandfathers are certainly a sprightly lot, I thought.

The girl paid Eusebio, thanked him, picked up her bundle, and departed. We walked across the patio and greeted the old man, who was returning the coca leaves to his pouch.

"Hello, Eusebio," I said, shaking hands. "Grandfathers seem to be everywhere." Clemente translated, and Eusebio looked up at me solemnly. His wrinkled face was framed by the white knitted cap worn by venerable Aymara men.

"They *are* everywhere," he said. "And they know everything."

I had never heard such an extravagant claim made for the omniscience of old age. I didn't quite know what to say next.

"Are you as mean to your grandchildren as the grandfather of that girl who was just here—the one who lost her llama and other things?"

Eusebio stared at me blankly and then burst into laughter. He laughed until tears ran down his lined cheeks.

"You don't understand," he gasped. "I wasn't talking to that girl about people—at least, not about humans." He wiped his eyes, and his shoulders shook. "We call the spirits 'grandfather' because they are really a part of the family."

In his amusement, Eusebio forgot his reluctance to discuss the native religion. Now he was anxious to make me understand.

He suddenly became sober and explained carefully, glancing from me to Clemente and back again.

"The spirits are everywhere. They live in the mountain peaks and rivers, in caves, and in the lake. Some live on the high, windy *punas,* some in the bubbling hot springs. Wherever there is a house there is a spirit, and these spirits take care of the Aymara. That is why we must never neglect them."

The pieces of the puzzle were at last beginning to fall into place. Then I remembered the Chokelas.

"I saw you yesterday at the shrine of San Bartolomé," I said. "You were with the Chokelas. Tell me about them, Eusebio."

The Old Evasion

The old man stood up, and his reserve descended around him like a curtain. "I do not know about the Chokelas," he replied briefly. "I am a diviner. I can read the coca leaves. But I am not a magician. I have never been struck by lightning."

Magician? Struck by lightning? At every mention of the Chokelas we came up against another blank wall.

Eusebio turned to go. "To talk to the spirits, one must be a magician. My nephew Martín is studying to be one. He was the Little-eared Grandfather yesterday. Perhaps if you were to speak to him——." The old man went into his house.

"Little-eared Grandfather," I growled to Clemente as we left. "I guess we'd better give up!"

It was some months later that I became acquainted with Martín. He was a stocky, sullen young Aymara who lived in a hut of sod blocks on the very edge of Lake Titicaca. Our one bond that transcended his hatred of white men was our mutual love of fishing. With Clemente acting as go-between, a fishing trip had been arranged.

Early one morning I shivered knee-deep in freezing mud while Martín readied the fishing *balsa.* In the east, the yellow light of dawn had just begun to glimmer over the rocky Peninsula of Chucuito. Fat Andean geese awoke noisily to begin their morning's feeding. Slender pink flamingos fished gracefully among hummocks of *totora* reed.

Martín dragged the *balsa* ashore, wading barelegged through the thin ice at the water's edge. Without speaking, we drifted ghostlike into the pale lake.

Martín cast his net and turned to me. "My uncle has said you will ask about the Chokelas. He says you are very persistent." He spread his hands. "Yes, I was the Little-eared Grandfather at San Bartolomé. Yes, I am learning to be a magician. Shall I tell you how it was?"

He tugged at the net and helped himself to a chew of coca.

"What I'm telling you about now happened a long time ago—when I was a little boy. That time I was herding sheep up on the slopes of Atoja Mountain. Big black clouds were blowing up from across the lake, and I lay down behind a stone wall because it was raining hard. Then there was a flash of lightning —*kon!*—and a ball of fire rolled across the meadow toward me. It killed me, but another flash of lightning brought me back to life again. In between, I saw the spirits, shining and bright, and I knew that they had chosen me."

"Look," he leaned forward and parted his coarse black hair. "See where the lightning burned me?"

"And what then?" I prompted.

"Nothing right away. When I got older I learned to read the coca leaves. Later I decided to become a magician, and I went to see Manuel Barrientos."

The sun had come up, but Martín ignored his net. The *balsa* drifted among the reeds.

"I told him what I wanted," he went on, "and Manuel Barrientos agreed to teach me everything. He taught me how to make offerings to the spirits and how to speak with them—the spirits of the mountains and rivers. I can even talk to the dead."

He paused and looked at me intently to see whether I believed him.

"The spirits tell me the reasons for all the evil things that happen in this world. With their help I can fight witchcraft and epidemics and misfortune of all kinds."

He lapsed into thoughtful silence. Gently I asked the question: "What, Martín, are the Chokelas?"

Martín stood up and poled the *balsa* into deeper water. He looked away across the hills, avoiding my eyes. When he answered, I was not surprised.

"Perhaps Manuel Barrientos will tell you," he said.

A Hermit Herdsman

Late in April, a little more than a year since I had first heard of the elusive Chokelas, I climbed the stony trail over Atoja Mountain to the high pasture land beyond the lake shore. And I was going to visit the one Aymara—Manuel Barrientos—who could tell me what I wanted to know.

He was a quiet, withdrawn man, who lived the lonely life of a herdsman in the bleak *puna* country. I had cultivated Manuel long and cautiously on the pretext that I wanted to study how the Indians raised llamas. I stayed with him on the remote ranch where he tended his flocks.

We wandered daily across the empty grasslands or sat in the shade of crumbling burial towers built by the ancient Aymaras. We talked about many things. Secretly, I think, he enjoyed the companionship. Gradually his answers became less guarded.

But life in the *punas* was cold and lonesome, and I longed to return to Chucuito. The opportunity came when Manuel decided to drive a herd of llamas to market. As we left the high plain and traversed the mountain trail, Manuel kept up a running commentary about the animals and birds we saw around us. He had lived alone among them for so long that they were his friends. He chattered idly about the condor and the fox, the puma and the wildcat.

In the distance a herd of fawnlike vicuñas, wild relatives of the llamas, nibbled at dry grass and lichens.

"There are the *wari*, the children of the Chokelas," he pointed, giving me an appraising, sidelong glance.

I said nothing, and we traveled in silence.

We reached the big cairn at the summit of Atoja Mountain and stopped to rest. Lake Titicaca and Chucuito were spread out before us. Manuel deposited a quid of coca leaves upon the cairn, staring at me intently.

"Why do you want to know about our most secret beliefs?" he asked point-blank. "Other white men have wished to destroy them. Do you?"

So I hadn't deceived him at all. I sighed. "No, Manuel. I want to write a book about the Aymaras so that people in my country will understand them. I don't want to destroy anything."

We started down the trail toward the village. Manuel gazed straight ahead, but he took no notice of the llamas as they picked their way among the boulders.

When he spoke again, it was slowly and with reverence. "The Chokelas are the spirits of the *suni*, the high, cold *punas* where no men live. They are the old men of the mountains."

He paused, and I said nothing. I was afraid to breathe.

"The leader of the Chokelas is called 'Big-eared Grandfather,' and his helper is 'Little-eared Grandfather.' Martín and I bring these spirits to Chucuito once a year."

The trail now wound past fields and houses, and Manuel devoted his attention to preventing the straying llamas from trampling the standing crops. We entered a cobbled street, walking between high stone walls, past a fountain where women were drawing water. We crossed the upper plaza of the village, dominated by the great seventeenth century church of Asunción, and passed into another narrow alley.

Halfway down the block, Manuel drove the llamas through a gateway in the wall, across the courtyard of his house, and into a corral. He motioned me inside and spread a poncho for me to sit on.

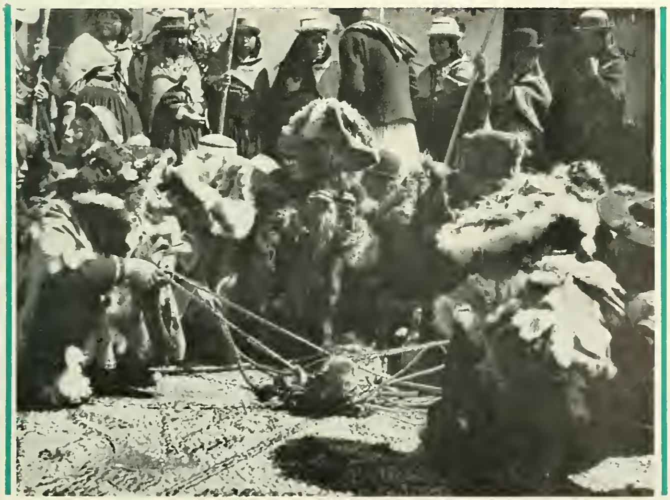
I lit a cigarette, and he spoke again.

"If we remember the Chokelas once a year at harvest time, they send us health and happiness, good crops, and large flocks. But like our forefathers, we must honor them each year with sacrifices at the shrine of San Bartolomé."

He went into the house and returned quickly with a large jaguar-skin pouch, his eyes shining.

"This bag contains our most sacred amulets. There is an old story——."

▼ **THE VEIL OF SECRECY was drawn aside as the ancient rite was enacted in the author's patio. The Chokelas have snared the "vicuña," while the Big-eared Grandfather pours a libation to the spirits.**



The Village Sophisticate

A jeering laugh brought us suddenly to our feet. Leaning across the compound wall was Carlos Apasa, his lips twisted in a derisive smile. Carlos was the young man-about-town in Chucuito, the smug schoolboy, the sophisticate. His short hair was heavy with pomade, and his tight jacket and loud necktie aped—or rather, burlesqued—the latest fashions of Lima.

"Chokelas, amulets, old stories—," he sneered. "Who today believes such foolish superstitions?"

Manuel was shaking with rage. He snatched up his pouch, fled into the house, and slammed the door. Mocking laughter rang through the courtyard. I could have beaten Carlos within an inch of his life.

I did not see Manuel again until the second of May. The villagers had been busy with preparation for the big fiesta on the following day, and Indians were arriving from the near-by towns. Throughout the village newly dyed skirts and ponchos dried over stone walls. The music of orchestras rehearsing sounded well into evening.

The knocker on the street door banged, and the houseboy went to answer it. Manuel Barrientos stood in the gloom of the arched doorway.

"I wonder," he asked tentatively, "if I may visit you tomorrow morning before the Chokelas go up to the shrine of San Bartolomé? There is something important I must tell you."

I could scarcely say that nothing would please me more, before he vanished down the darkening street.

During breakfast the next day we listened to the shouts of the revelers outside. From our window we could watch the climbing lines of people. It seemed impossible that an entire year had passed.

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Christmas Flower

Pointers on the care of the colorful poinsettia, a flower whose cultural roots go deep into the legend and lore of the Americas

By Audrey B. Haines

STROLL down the streets at Christmastime when the florists' windows are gay with holiday displays, and you may notice that holly is gradually giving way to a crimson tide of poinsettias.

Most observers think of this radiant flower as a relative newcomer, but actually it is very old. It has witnessed the rise of more than one civilization. In the very dawn of history on the American continent, when a pagan and beauty-revering race left the record of its civilization in the magnificent ruins of Yucatán, the poinsettia – under what strange name, we do not know —was there.

When, centuries later, Cortes scuttled his ships on the shores of the New World so that his little band could not look back hopefully to retreat but only forward to victory in the conquest of Mexico, this same bright flower marked the line of march like beacons. More than 125 years ago the United States first saw the poinsettia. When in 1828 Joel Roberts Poinsett was our first Minister to Mexico, he became interested in the Flower of Christmas Eve—as it was called in that country—and brought back cuttings for the gardens of his estate in Charleston, South Carolina.

A Scottish nurseryman of Philadelphia named Robert Buist persuaded Poinsett to sell him a few cuttings. Buist classified the plant as a member of the spurge family (Euphorbiaceae); later it became *Euphorbia pulcherrima* ("the most beautiful"). It has other names and nicknames. In Mexico it is known not only as the Flower of Christmas Eve but as the Mexican Flame Leaf. Nicaragua calls it the Shepherdess, and in Argentina it is known as the Federal Star. Other names include Easter Flower, Christmas Flower, Lobster Plant, and the Painted Leaf.

Roots sensitive to shock

The poinsettia is not without its peculiarities, too. It is sensitive to any shock that will jar its roots and to the chill of a cold cement floor. (Better avoid putting a potted poinsettia on the cellar floor or watering it with water that is below 60° F.) A plant that is suffering from cold shock can be revived by submerging it in warm water.

Anyone who looks carefully at a poinsettia "flower" will find it a rather puzzling object. It is not at all like the flowers we are accustomed to. It looks more like a group of brightly colored leaves on top of a closely branched twig. In fact, that is actually what it is. The red objects that look like petals are simply red leaves, very little different—except in color—from the green leaves of the rest of the plant. The real flowers are clustered in tiny yellow club-shaped objects, which grow practically unobserved at the center. The poinsettia, then, is a whole group of tiny "flower clusters," or inflorescences, surrounded by a collar of red leaves.

This plant is not the only member of its genus that does this sort of thing. The euphorbias make a specialty of surrounding their inconspicuous flowers with flashy leaves. The old-fashioned ornamental called Snow-on-the-Mountain (*Euphorbia marginata*), with its striking white-striped leaves at the top of the plant, is another. And there is a euphorbia of Madagascar that became associated with the Christmas tradition—the so-called Crown of Thorns (*Euphorbia splendens*).

Winter is a critical time for poinsettias. Whether this festive plant will lend its flaming red bracts to the brightness of the Christmas season depends largely on how well it is spared certain pre-Christmas hazards. In its native tropics, the poinsettia gets almost equal days and nights. But in the American home, with electric lights and our modern habit of staying up long after the sun has gone down, we are not likely to supply the natural rhythm of light and dark that brings out the best in the poinsettia.

Home growers of poinsettia should place the plant by a window so that it will get the maximum of winter daylight. At night it should be covered with a dark cloth, as though it were a pet canary being prepared for sleep. Even with this care, the home grower may have difficulty bringing the poinsettia successfully into bloom.

Darkness affects blooming

It has been found that the blooming of the Christmas plant can be speeded up or held back by varying the ratio of daylight to darkness. Scientists of the United States Department of Agriculture have proved that administering minute quantities of light for an hour each night for three weeks is enough to prevent flowering. The secret of making the plant bloom is to keep it in the dark for at least thirteen hours a day. If cuttings are started in late summer or early autumn and kept in total darkness from fourteen to sixteen hours a day, the flowers and scarlet leaves will bloom for Christmas. Less than thirteen hours of darkness will delay the blooming greatly. If the dark periods are broken too often, the plant will fail to bloom at all.

Light and even temperature

In caring for your poinsettias this Christmas season, remember that they like a warm, moist atmosphere and damp, sandy soil. To preserve the handsome state in which they come from the florist, give them plenty of light and water and keep them in a temperature of at least 68 or 70 degrees. Maintain an even temperature in the room. Drafts or sudden temperature drops may cause the foliage to fall off. Weekly applications of liquid manure are also helpful.

After your poinsettias are through blooming, place them just as they are in a dark part of the cellar for the winter months. In the spring they should be cut back to the hard wood, repotted, and placed outdoors. (The cuttings, which should be from three to four inches long, may be placed in sandy soil and potted later.) Then, in mid-August or early September, the plants should be cut again. If you live in a cold climate, they should be brought indoors. Fortunate is the man with greenhouse facilities, for he may overcome the problems besetting the average home grower and witness a return of the same flaming beauty that livened his previous Christmas. Poinsettias thrive while outdoors during summer, but they are likely to drop their leaves in the dry and variable atmosphere of artificially heated houses.

At best, the poinsettia's blooming period is likely to be brief indoors. But for that week or two at the end of the year, it rules supremely as the gorgeous aristocrat of the floral kingdom. One of the sights that year-end tourists in Mexico City seldom forget is the open-air flower market on Calle Dolores, with its great banks of scarlet poinsettias.

In the United States, this Christmas flower is a million-dollar business. In New York City alone florists each year handle 150,000 potted plants, containing anywhere from 3 to 15 bright-red blossoms. The average retail price is $6.50, making a total of $975,000 for this single metropolis!

Today in the northern states, great quantities of poinsettia are grown in greenhouses. Where the climate is mild, as in Bermuda, Florida, and Southern California, the plant lives outdoors as a perennial. There it may become a shrub up to fifteen or more feet in height. The poinsettia also grows wild in moist, shady areas of Central America and Mexico. Some varieties bloom in October, others in January. And it might be said that the parent plants never know what their young seedlings will grow up to be, for the species is variable and there are differences in detail from generation to generation.

At Encinitas, California (between San Diego and Los Angeles), Paul Ecke has planted 400 acres of flaming poinsettias, covering the hills just off the coastal highway. Here two crops a year are harvested. In early spring, tractors dig up the major crop—dormant brown roots, the consequence of 100,000 cuttings planted the previous spring. These are boxed and shipped out by the carload. It is a rush harvest, for each grower wishes his new stock to arrive on the Monday after Easter. That is the first day he has time to begin, and he wants to start at once in order to prepare his blooms for Christmas.

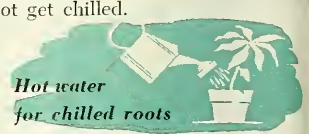
The second crop, while only a by-product of the first, is the spectacular one. For three weeks preceding Christmas, hundreds of thousands of brilliant blooms are cut, packed in dry ice for shipment to Hawaii and the Atlantic coast. Skilled workers cut in the fields from daybreak until dark, while runners stand by to load the flowers over their shoulders, 40 to a bunch, and carry them to the nearest processing station, which is usually just a temporary shed located in the field. Here the stems are immediately boiled to seal in the milky fluid so that the poinsettias will stay fresh.

A much more drastic treatment is given them in the big warehouse. They are dipped, bloom and all, into an acid bath, which further cures them. Then they stand in deep, five-gallon tin cans of cool water and appear the gayest, most crowded shedful of flowers that you ever saw, awaiting packing and shipment overseas by air express or by truck and double-deck trailer to the Los Angeles wholesale flower market. Los Angeles is the only big city in the United States where the poinsettia is sold as a cut flower.

Cut and burn
stem ends

If you should receive cut poinsettias for Christmas, you can prolong their life by continuing the grower's treatment. Keep them in deep, cool water in a room where they get plenty of fresh air. Rejuvenate them now and then by cutting a few inches off each stem and burning or boiling the cut briefly to seal the stalk. Then give them an overnight soaking in a bathtub of cool water. Gently push each bloom down into the water. It will float to the surface again, refreshed and not bruised if you are careful. But do not take a shower in the same room, because poinsettias do not like steam.

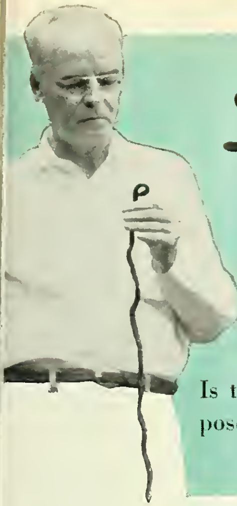
Nine chances to one, your poinsettias will come potted. Then there are a number of things you can do to keep them blooming happily. They no longer need the 68 or 70 degrees of temperature they wanted while *growing*. When they are in full bloom, they like cool, moist air and can be held by reducing the temperature to between 50 and 60 degrees. Hence if you keep your thermostat low, you will be conserving your flowers as well as your fuel. At night, put them in your bedroom or on a glassed-in porch, where the air will be refreshed. But keep them away from an open window so that they cannot get chilled.



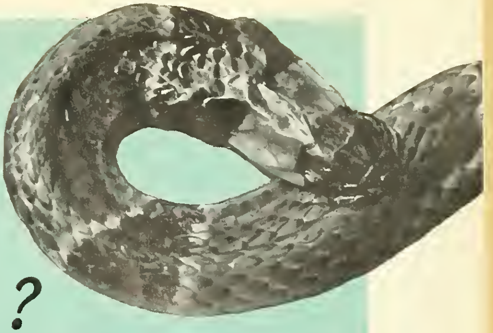
If your poinsettia plant should have gotten chilled on its way to your house, it may wilt in the warm air of your room. Then water it at once with hot water—as hot as your hand can stand. This startling treatment will take the chill out of the pot and warm the roots. In 30 minutes or more, your plant will be brisk and sturdy again.

In the years since Poinsett brought home the first cuttings, growers have developed larger and finer plants, more and more brilliant and longer lasting. White and pink varieties have been produced, but the original red has retained top billing. Like all specialists, Paul Ecke is an ardent experimenter. He watches for handsome sports among his poinsettias and works to develop them true to their type. Hence it is no wonder that he has pink, yellow, and cream-colored poinsettias. He now has near perfection a magnificent new one with a coral-colored blossom.

Poinsett always urged his traveling friends to bring home new plants. "If one of these succeeds," he used to say, "you will be rewarded by a consciousness of having conferred lasting benefit upon your country." Surely no one for whom the poinsettia has become a customary part of Christmastime can fail to be grateful that Poinsett practiced what he preached.



Do Snakes Commit Suicide?



Is their own poison fatal to them? Would they bite themselves on purpose? Scientists can't ask the snake but think they know the answers

By William E. Lundy

"THERE is a pretty snake in our back yard, and it looks as though it has committed suicide," my wife told me one afternoon as we drove home from my office in Balboa, Canal Zone. "When I first saw it," she continued, "I struck it with a hoe, but it didn't move. Then I found that it had bitten itself on one side and had died with its fangs buried in its body."

I pressed the accelerator, hoping to reach home before some hawk or other creature got the snake.

We found the snake still there. It had apparently emerged from a burrow a few inches away from where it lay. The area had recently been sprayed with a Paris green solution. It was one of the ten or more species of true Coral Snakes found in Panama, probably *Micrurus nigrocinctus.*

In Mexico, the coral snake is known as the "Twenty-minute Snake," because any one it bites is supposed to die within 20 minutes. Fortunately, few have been bitten by this snake, for its venom, drop for drop, is as potent as that of the fer-de-lance, bushmaster, or its closer relative, the cobra.

The obvious question was whether our snake had killed itself with its own poison.

I recalled the stories people had told me of rattlesnakes that had killed themselves rather than crawl over a horsehair lariat with which they had been encircled. One tale told how a crippled moccasin had hastened its death by biting itself. On the other hand, I had read that most if not all venomous snakes are immune or highly resistant to their own venom, as well as to that of other snakes.

Hoping to get some enlightenment on these contradictory statements, I wrote to three outstanding institutions of natural history, asking whether venomous snakes are immune to their own venom. I pointed out that this coral snake might have died of Paris green poisoning after eating prey that had become contaminated. Could the snake have bitten itself in its death throes? Surely we could not suppose that it had done so intentionally to shorten its suffering.

A letter from Charles M. Bogert, Chairman and Curator of the Department of Amphibians and Reptiles at the American Museum of Natural History, expressed in essence the opinions given by the other two experts:

". . . To the best of my knowledge, every venomous reptile that has ever been tested is immune to its own venom. Venomous snakes are at least able to withstand injections of venom in quantities not exceeding the amount that would normally be expelled from their own glands. The literature does contain conflicting statements, but some fatalities can certainly be attributed to bacterial contamination of the venom used in experiments. Some years ago, I injected rattlesnake venom into a number of other species of rattlers as well as into harmless snakes. One succumbed; the others did not, even when they were given larger doses. I feel quite sure that the one victim was killed by infection introduced along with the venom.

"Yes, it is altogether probable that the Paris green employed as an insecticide was responsible for the death of the coral snake. Coral snakes do not eat insects, but they do prey upon lizards and upon smaller snakes, several of which are insectivorous. Also, your snake may have absorbed the insecticide in droplets of moisture, or otherwise from the ground that was contaminated by it.

"Snakes are susceptible to several insecticides, and while in their death throes, they do indeed bite themselves. It is not impossible that under such conditions a venomous snake might even penetrate some vital organ of its body. However, it would be beyond the realm of possibility that any snake should bite itself with suicidal intent."

So ends the Case of the Contorted Coral Snake.

nature unspoiled

Bergen Swamp

Rare flowers that trace their lineage to the Ice Age grow in this small preserve near Rochester, N. Y.

BACK in the 1930's a group of conservationists cast a concerned and longing eye on a 2000-acre tract near Rochester, N. Y. called Bergen Swamp. To these men its smallness had nothing to do with its uniqueness, and they wished to preserve it inviolate for all time. The Board of Regents of New York State gave them a charter under which to operate, under the title "The Bergen Swamp Preservation Society, Inc."

Conservationists believed Bergen Swamp worth saving because it is composed of the dwindling remains of the glacial lake Tonawanda. Arctic flowers, whose lineage dates from glacial times, still blossom here. The bird life is varied. Some warblers and snakes, uncommon to this vicinity, live and breed in the swamp. With these rare assets Bergen Swamp is a field ground for students and scientists, especially those from the near-by universities of Rochester and Cornell. It also fills a need that is felt deeply by many human beings to get away from the man-made clutter we live in and to drink for a while of the unspoiled wilderness. Such spots grow rarer all the time.

If you want to visit Bergen Swamp, turn off the main road from Rochester to Buffalo at the town of Bergen. The Swamp lies five miles northwest of the village at the end of Torpi Hill Road. You may encounter some bobcats, but it is more than likely they will see you first and take to the trees. It is also wise to know how to use a compass, because it is very easy to get lost in the Swamp.

The Bergen Swamp Preservation Society has succeeded in saving 833½ acres of this unique area for all the citizens of today and the future. NATURAL HISTORY Magazine applauds their success.

WHO WERE THE OLD MEN OF THE MOUNTAIN?

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Suddenly the street doors burst open, and Manuel Barrientos entered. Behind him came the entire Chokelas troupe—the musicians, the chorus of women, and the leaping, clowning, masked dancers.

In the unfamiliar quiet of the patio, the Chokelas fell silent, and Manuel spoke, his eyes focused on the stone mosaic floor.

"Our young people have forgotten us. They no longer follow our ways, but that is our problem. You are writing a book. I have investigated you as carefully as you have checked on me. Take your pictures. Write your notes. Write down everything you see and hear. I do not know how to write, but at least, in this way, nothing will be forgotten."

He nodded toward the "Little-eared Grandfather," and the whole fantastic ceremonial began. While the musicians piped and drums thudded, the women circled slowly, carrying tall poles joined by woolen cords. The masked Chokelas cavorted and grunted, mocking and insulting the spectators who had stolen into the patio to watch the sacred rite.

Over the music Manuel explained, "The Chokelas are the children of the mountain spirits. They behave roughly to show that they are not humans but superior beings from another world. They will not even speak the language of men."

Suddenly a man broke through the circle, brandishing a small stuffed animal, and the Chokelas darted after him in eager pursuit. The women began to sing, and Manuel continued: "The song tells an old story—how the Chokelas hunted vicuñas and drove them into corrals on the cold, windy *punas*, just as our ancestors did long ago."

"But that stuffed animal is certainly not a vicuña," I objected.

Manuel flushed. "I know," he said. "Today the hunting of vicuñas is prohibited by law, so we use a wildcat instead. We call it '*wari*', our name for the vicuña, and the spirits understand. The poles the women carry represent the corral where the animals were captured in ancient times."

The man with the "vicuña" dodged to escape his pursuers, and the women sang:

"The time and the hour are passing,
The wind and the rain will be coming,
The poles of the corral are ready,
Capture the wari, *Chokelas."*

Enmeshed in the slings of the Chokelas, who pantomined the words of the song, the "vicuña" was carried to Manuel, now kneeling beside the "Little-eared Grandfather." He opened his pouch with great dignity and drew forth amulets, seashells, offerings wrapped in newspaper, and a bottle of cheap red wine. Smoke curled from a tin can filled with coals.

"Kill the vicuña, Chokelas,
Cut his throat, Chokelas.
He must die that the Aymara may live."

I looked around at the shabby costumes, the battered stuffed animal, and the tin-can brazier, feeling embarrassed and depressed. These were the pathetic remnants of an age-old religious rite — warped, twisted, and emasculated by the prohibitions and the demands of the white man.

Bowing to the east, Manuel burned offerings of coca, wild mint, and llama tallow. Gravely he poured out libations of wine from the seashells, chanting, *"Spirits, here is your food!"*

The "Little-eared Grandfather" distributed bits of cooked meat to the crowd, telling them that the "vicuña" had been fat and healthy and that the omens were favorable. For another year the Aymaras would be blessed and secure.

Manuel waved his sacred pouch to the east, indicating that the enactment was ended. The Chokelas swirled out into the street to perform their rite once again, as tradition dictated, at the shrine of San Bartolomé.

Manuel turned to go. "You are just beginning to learn about my people. Come to see me tomorrow, and I will teach you. We must work hard. There is so much that you must write down before these things are forgotten."

I went into our house, still feeling depressed but somehow excited as well. The ghosts of memories were stirring at the back of my mind. Outside our window, the Chokelas were climbing to the sacred shrine.

Below the window stood a bookcase, and suddenly my eyes were drawn to a dusty stack of typewritten excerpts that I had copied long ago, before leaving the United States. They were passages from the Spanish chroniclers — Cobo, Bertonio Cieza de León, Acosta, and others—men who had seen Peru before the collapse of Inca civilization.

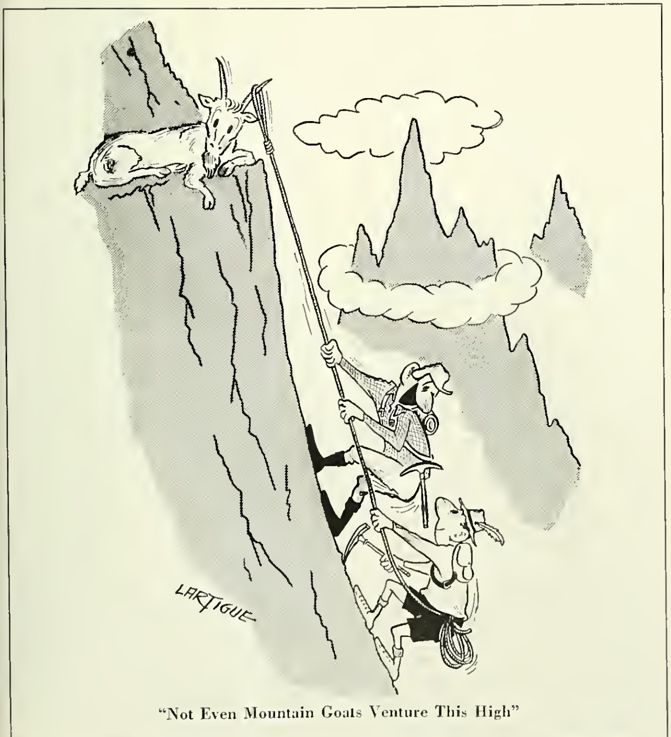
Under the pressure of field work, I had neglected them for many months. Now I leafed rapidly through the typescript pages. Here was a casual reference to mountain shrines, there a brief mention of the ritual use of vicuña blood. Farther along an entry in a sixteenth century Aymara dictionary described the trap then used to hunt these animals. There was even the name "Chokela," along with the cryptic translation: "wild men of the mountains." Taken with what I had just seen, these fragmentary references assumed new meaning.

Gradually the past merged with the present, and in my imagination I could look across the span of four centuries.

* * *

I saw Chucuito as a great city once again. Beyond it, on a plain across the mountains, thousands of Indians ring the *pampa,* for the Inca governor has ordered a communal vicuña drive to be held. From all directions the Indians converge, singing, shouting, and beating drums. Their multicolored cloaks flap in the wind, and their dogs race on ahead, driving hundreds of vicuñas toward the corral of poles and woolen cords. The terrified animals leap and dart, driven by the din behind them toward the center of the ever-closing circle.

Once in the corral they mill wildly, shying away from the yarn tassels that flutter from the poles. One by one they are seized, and while the hunters hold them, the women shear them close with sharp bronze knives. From the shorn fleece, fine fabrics will be woven for the nobility. Wounded animals are killed for food, but the rest of the herd is released unharmed—except for the sacrificial victim—a handsome male vicuña. Soon after, in the month of the "Little Harvest," which corresponds to May, when the first po-



"Not Even Mountain Goats Venture This High" tatoes are dug, the priest-magician will name a day for the ceremony.

Runners spread the word in the outlying districts, and chosen women, dedicated to the shrine, prepare quantities of *chicha* beer especially for sacrifice.

The procession to the sacred mountain blazes with color. Borne aloft on swaying litters, the Inca governor and the Aymara nobles ride above the crowd, canopies of featherwork shielding them from the curious glances of the peasants. The sun shines on their tunics and robes of finest tapestry. On their heads they wear turbans and diadems of parrot and flamingo feathers, and their costumes glitter with gold and silver ornaments. Attendants walk beside the litters, carrying standards and heraldic insignia. Music blares from flutes, panpipes, and shell trumpets.

Behind them swarm villagers from the distant farms, singing and dancing in celebration of a successful harvest. Porters carry great painted jars of *chicha* for refreshment and ritual. Pack trains of llamas, with colored tassels and bells hanging from their ears, transport loads of fragrant wood for the sacrificial fire.

On the summit of the dome, the masked Chokelas snap their slings and burlesque the onlookers. Even the nobles bear their insults with good humor, for the spirits hold no respect for caste and class.

"Kill the vicuña, Chokelas,
Cut his throat, Chokelas . . .,"

sing the women. There is a hush a the "Big-eared Grandfather" lead the vicuña around the shrine. Then uttering phrases of dedication, h turns the animal's head toward th east and slits its throat with a swif stroke. Blood spurts into a carve stone basin as the "Big-eared Grandfather" sprinkles *chicha* over the dying vicuña and burns coca and othe offerings on the sacrificial fire. H inspects the spleen of the butchere animal for omens of good or evil The flesh of the vicuña is distribute to the crowd. Bowing toward th setting sun, he concludes the ceremony.

I closed the folders, and looked out at the rocky dome. If only in spirit, the past seemed to have lived on into the present.

MAN'S OLDEST DATE IN AMERICA

continued from page 517

Vegas area last spring. Only one undoubted stone artifact was found this time, a crudely chipped piece associated with bones. However, several other stones may have been slightly worked, or used, or both.

On leaving the site, we planned to return at a later date with a larger party prepared to stay longer. We had excavated most of the ash-beds or bone-beds that had been exposed by erosion, but we felt practically certain that more would be revealed if we could remove the partly eroded lake deposits in the ancient camp areas. This would entail considerable heavy work, and we might not encounter anything different from what had been found before; but on a site of this age, the effort should eventually be made.

How may our finds be interpreted? First of all, it is evident that a band of hunters camped on low clay knolls, probably on the bank of a stream, in what is now the Las Vegas Valley, "more than 23,800 years ago." That is to say, away back in the Pleistocene period, commonly known as the Ice Age. Their main campground, so far as it has been uncovered, measured about 625 feet by 200 feet.

In some way (we do not know how), they managed to kill the animals of that period for food—mostly the Camelops, or large American camel, but also the long-horned bison, two species of American horses, a deer, and even the mammoth, or American elephant, all long extinct. They brought these animals, or parts of them, back to their campground, cooked and ate them, even breaking or splitting all the long bones for the marrow.

Their method of killing the animals is a real riddle, because we found no spear points, in fact no weapons of any kind. They may have used hard wood or bone points for their spears. The bones examined at the American Museum showed that many of the animals were very young or aged individuals, which of course made them easier to kill.

These people apparently used sharp flakes struck from blocks of stone for cutting—such as the obsidian flake found by Mr. Hunter. And we think the stone chopper was used to break and split bones for the marrow. Our large stone "scraper" could also have been used for this purpose, if not for scraping hides.

The hunters usually left the animal bones where the flesh had been cooked and eaten and the bones split, often throwing them into the dying fire, for which reason some bones show burning. However, we found a few instances where natural cavities in the ground had been used as ash-dumps. As before stated, we found in one of these the still connected bones of a camel's foot, which had apparently been hacked off and thrown into the dump. In at least one case, the people had dug a special pit for cooking the flesh of one or more camels.

We know that shortly after the hunters abandoned their campground, a rainy period created a large pond or shallow lake in the area, which left many small pond-type shells, even directly on or in the ash-beds. And this lake or pond, or a succession of them as time went on, eventually deposited as much as 21 feet of silt on some of the lower ash-beds. The average thickness was about 14 feet, but this varied with the height of the original clay knoll on which the people had camped. Then a very dry period came, and with the disappearance of vegetation, erosion set in, developing the present Vegas Wash and its tributaries. These carried away part of the lake deposits, exposing again the long-buried ash-beds on what had been the original floor of the valley.

The ancient campsite was used in a comparatively dry period. There followed this a very long wet one, and after that came a very dry one. Thus the occupation of the ancient campsite may well date from before the last advance of the Pleistocene ice, which would fit this climatic sequence. For, as the continental ice sheet melted, it is likely that there was a period of damper, warmer weather. If this be the correct interpretation, the cultural horizon represented might be named "Pre-Mankato," the name Mankato having been given to one of the last minor advances of the glacial ice.

That is all we know as yet concerning "Tule Springs Man," but as time goes on we may be sure that there will be more discoveries, and probably older dates, for early man in America. We may even find the answer to the question: "If the Tule Springs deposits are 'more than 23,800 years old,' how much older are they?" Perhaps more sensitive equipment or different methods will eventually tell us.

The Screen

Authoritative comments on films in the field of nature, geography, and exploration

Edited by Elizabeth Downes

"White-tail Buck"

Reviewed by T. Donald Carter

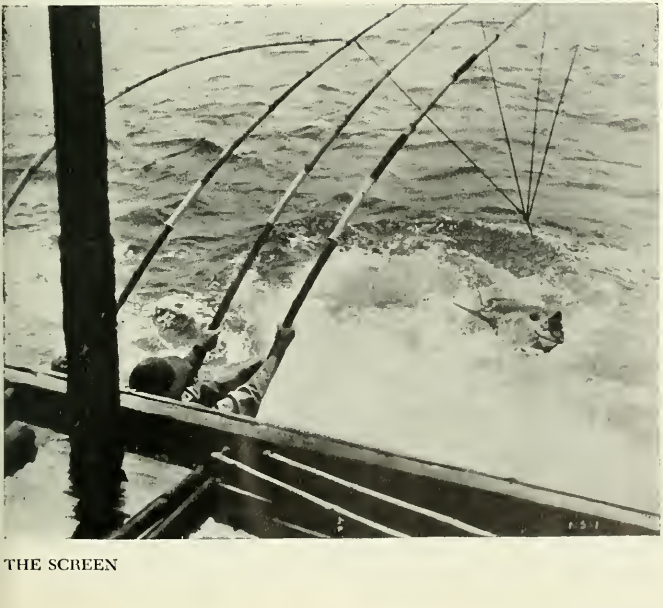
Assistant Curator of Mammals
American Museum of Natural History

THE main theme of this film is the instruction of a young boy in the art of deer hunting. The setting is our northern woods in October and November. The autumn coloring and the first snow give the picture a beauty that cannot be matched anywhere else in the world. There are numerous excellent shots of the white-tailed deer in their native environment as well as of some of the smaller animals that share the country with them.

The final success of the boy in obtaining his buck will undoubtedly be witnessed with a mixed feeling; the hunter will share the boy's triumph, while many nature lovers will wish that the story had had a different ending.

The narration is well done and, with the exception of calling a black-capped chickadee a sparrow, is accurate and entertaining.

Released by R.K.O.
Technicolor
Running time: *33 min.*



The Naked Sea

Reviewed by Francesca LaMonte

FILMED on location, "The Naked Sea" has as its central dramatic core the story of live bait fishing on one of our Pacific tuna clippers. In this method of commercial fishing, when a school of skipjack, yellowfin tuna, albacore or bonito is located, live bait is thrown out, and the fish appear in a rush on the surface. They are then caught by heavy bamboo rods attached to short lines, at the end of which feather lures conceal a barbless hook. If the fish averages over 30 pounds, two poles and two lines are attached to one lure, and it sometimes requires as many as four men to make the catch. They fish from a platform beyond the main rail of the ship, almost level with the constant wash of the sea. When the fish takes the hook, the rod is swung upward and back, landing the catch on the deck behind the ship's rail. It is beautiful to watch the rhythm with which the men handle the heavy poles without tangling lines and to see their perfect coordination when more than one person fishes on a lure. Waves breaking over the slender low guard rail, the increasing speed of the take if the run is large, and the grim determination on the men's faces in their effort to achieve tonnage necessary for a profit, is splendidly photographed. This part of the film could be much longer and would still hold the interest that other portions, unfortunately almost equal in length, fail to do. The continuity, poorly written and delivered in a hollow declamatory style, is detrimental to the film.

Released by R.K.O.
Technicolor
Running time: *78 min.*

CONSERVATION NEWS

continued from page 505

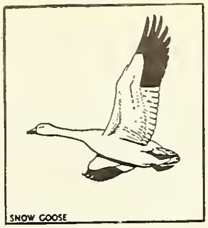
ward over Saskatchewan, North and South Dakota, Nebraska, Kansas, Oklahoma, and thence to their protected marshes near the southern tip of Texas.

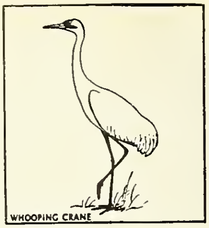
Good news now comes with word that 28 of the birds have arrived back in Texas, including 8 young raised this year. One adult appears to be missing. The fact that the nesting grounds in Canada, as now known, are within the preserve known as the Wood Buffalo Park ensures the birds some protection without special regulations. Nevertheless, the Director of Canadian Wildlife stated at an Audubon meeting in November that steps would be taken, if necessary, to bar low-flying planes from nesting areas.

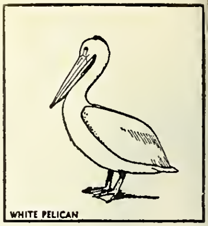
The drawings at right will help you recognize the Whooping Crane.

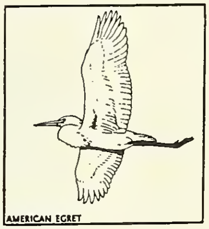
Wichita Wildlife Refuge

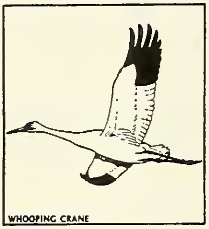
Another wildlife refuge that has been requested for Army use is the 10,700-acre Wichita Mountains National Wildlife in Oklahoma. A surveying party was on the Refuge earlier this fall collecting topographic information. Intended Army use of the area included the testing of a gigantic 280-mm. cannon in conjunction with developmental work at Fort Sill Guided Missile and Artillery School. However, Sec. of the Interior Douglas McKay announced on Oct. 20 his opposition to transfer of the Refuge to the Army.


SNOW GOOSE


WHOOPING CRANE


WHITE PELICAN


AMERICAN EGRET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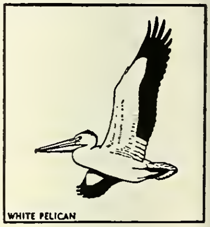
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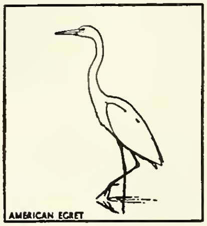
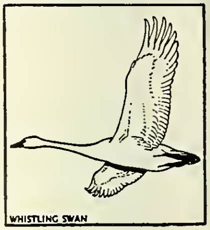

AMERICAN EGRET

Note the pictures of the Whooping Crane and of other white birds with which it may be confused.

THE WHOOPING CRANE:

Stands over 4 feet tall.
Has a wing-spread of 7 feet.
Flies with neck and legs out straight.
Has a white plumage except for black tips on wings.
Has black legs and yellow bill.
Has a bare red crown.
Usually nests in big marshes.

Illustrations by W. J. Breckenridge


WHISTLING SWAN

Echo Park Dam

The controversial proposal to build Echo Dam in Dinosaur National Monument in contradiction to the immunity that National Park Service lands legally enjoy from such structures has ceased to be an issue, at least temporarily. The disputed dam was dropped from the Upper Colorado River Project, and a plan for carrying out this vast water development system without Echo Dam has been drafted for consideration by Congress.

Panther Dam

At the polls on November 8, voters of New York State opposed in the ratio of approximately 3 to 1 the construction of the so-called Panther Mountain Dam on Forest Preserve land in the southwestern portion of Adirondack Park. Those who were interested in the construction of the dam for electric power argued that it would have value in flood control. Those who opposed the dam pointed out that less than 11% of the water-flow in the lower valley comes from the river concerned, and they opposed the invasion of the Forest Preserve on the grounds that this dam would be an opening wedge for many other similar encroachments. Nearly 40 other dams are currently being discussed in connection with the Adirondack region.

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10. Temptation, Go Away
11. Yonder Comes a Sucker
12. I Don't Care
13. Cattle Call
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